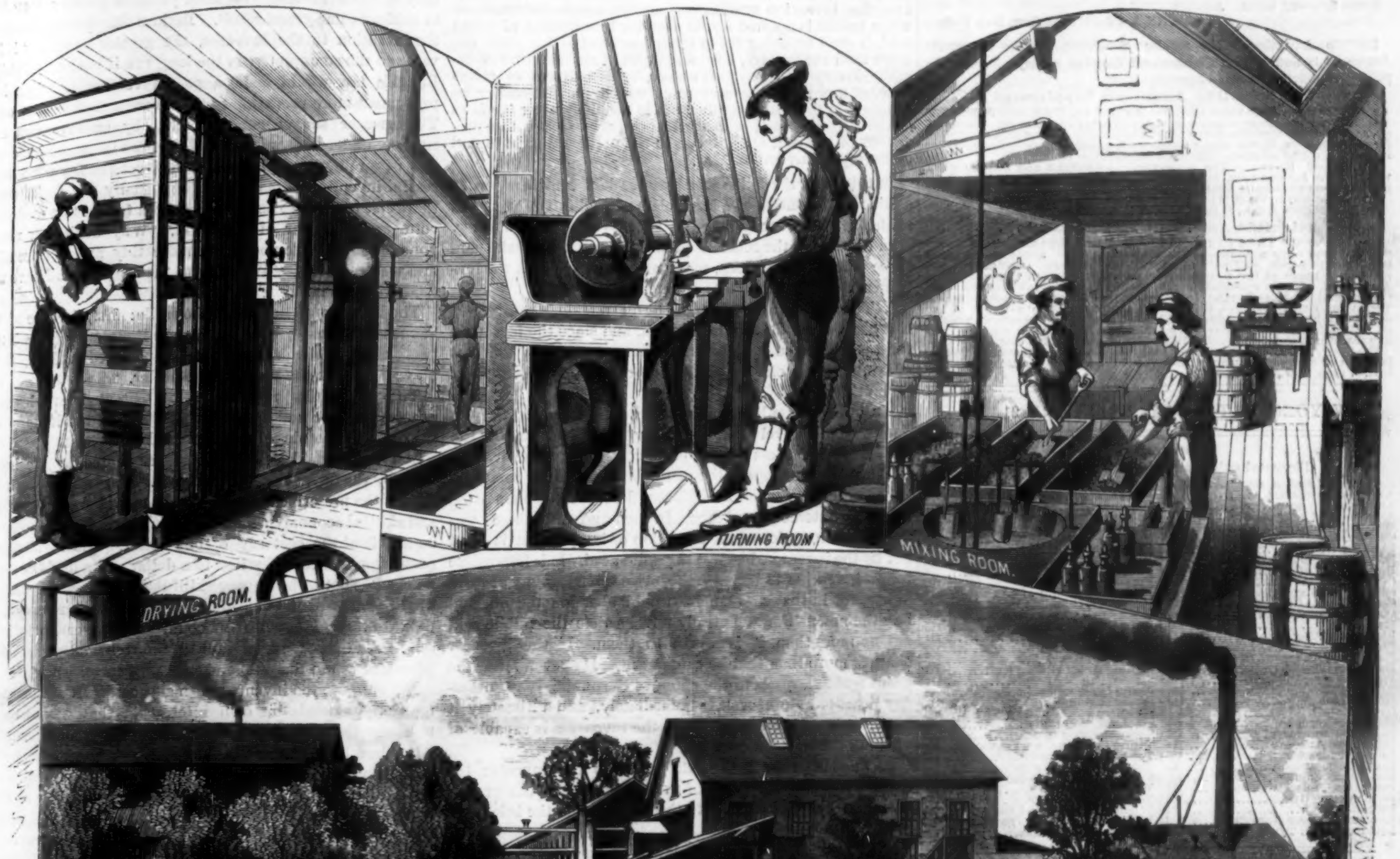
Hunt →

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLII.—No. 8. [NEW SERIES.] NEW YORK, FEBRUARY 21, 1880. [$3.20 per Annum. [POSTAGE PREPAID.]



THE MANUFACTURE OF SOLID EMERY WHEELS.—WORKS OF THE TANITE COMPANY, STROUDSBURG, PA.—[See page 117.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

NEW YORK, SATURDAY, FEBRUARY 21, 1880.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 216.

For the Week ending February 21, 1880.

Price 10 cents. For sale by all newsdealers.

MR. CONVERSE'S PATENT BILL.

In our issue of January 17, the bill introduced in the House of Representatives by Mr. Converse, of Ohio (H. R. No. 2,913), was reprinted as it was received from the government printer. The author of the bill now informs us that by a clerical error the words "who shall knowingly violate the provisions of this act," had been omitted from the final clause as officially printed, and that the bill properly reads as follows:

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That it shall be unlawful for any owner, or part owner, or assignee of the whole or any part of any patent granted or pending under the laws of the United States, to charge or receive as royalty on such invention or discovery more than an amount equal to the cost of production, and twenty-five per centum to be added thereto for profits of manufacture in addition to such cost, and twenty-five per centum profit. Whenever the invention or discovery or the article patented, or when patent is applied for, is used for hire instead of being sold, it shall be unlawful to charge or receive for such use more than the royalty, cost, and profit of manufacture aforesaid. Every owner or part owner, by assignment or otherwise, of any patent heretofore or which may hereafter be granted, or for which application is pending under the laws of the United States, who shall knowingly violate the provisions of this act, shall forfeit to the public all right to said discovery or invention."

In this form the bill is worthy of serious consideration as a fair representative of a large class of well-intentioned but mistaken efforts to regulate the business affairs of patentees.

In discussing the relation between those who make and those who use inventions, many are apt to overlook the fundamental facts of the case; among them these:

1. To live, an invention must be of practical utility. If it is useless it is dead to begin with, and since the fees paid for a patent on such an invention more than cover the cost of issuing it, no one but the inventor loses by or because of its inutility.

2. An invention lives and pays when it furnishes a product which is novel and useful; or when it improves the quality or usefulness of some product already in use; or when it improves or cheapens the methods of producing some existing article; or when it facilitates (like the telephone) the necessary intercourse of men. In each and all of these cases the maximum price of the invention or its product is fixed not by the inventor, but by the public need. It is impossible for an invention to increase the price of anything already in use, for in that case no one would abandon the old and buy the new. For an entirely novel article the public will pay no more than it is worth to them. If the inventor charges more than that he cannot sell. However large the profit which accrues to the patentee the public is of necessity benefited more or less immediately, and ultimately it receives the entire benefit which the invention is capable of yielding.

3. The larger the immediate profit to the inventor the greater the practical value of the invention, and the greater also the legacy which falls to the public when the brief term of the patent expires.

4. The object of the patent law is to hasten the development of the useful arts by holding out inducements to all men to exercise their inventive faculties and publish the results of their labors. These inducements cost nothing to the community, and in the aggregate they yield to the nation large benefits directly and indirectly.

5. The experience of the past century proves that it pays to encourage invention as a means of advancing the useful arts. It proves, moreover, that it pays to encourage invention by giving the fullest protection to the inventor's constitutional property rights. Where inventors have been most liberally treated, there their work has been most active and beneficial, and there social and industrial progress has been most rapid.

In view of these fundamental facts, any attempt to arbitrarily interfere with the property rights of inventors and patentees, or to arbitrarily limit their profits, is objectionable for such reasons as these:

1. The act would be one of gross injustice.

2. The act would be impolitic and contrary to public interest.

3. The attempt to limit the price of patented articles by such means would be entirely futile.

The injustice of the act lies in its unwarranted discrimination against the holders of one particular kind of property. There is no species of property which is more honorable to the holder, or which has contributed more to determine the character of modern life and to advance the wealth, power, and industrial supremacy of the American people, than that which is or has been covered by or developed under patent rights for invention. By a single achievement the inventor not unfrequently creates or makes available in the course of a few years more power and more wealth then a million other men can produce by a year of hard work on the farm or in the factory. By far the larger part of such created wealth and power accrues not to the inventor, but of necessity to the nation at large. Still the inventor's possible reward is great (and this is the chief incentive which urges men on to invent), but the greatness of a man's profit in other lines of endeavor is not made a pretext for public interference and legalized robbery. Some lawyers make enormous gains from their professional practice. Would that fact justify a law to the effect that no lawyer should receive for his services in any year more than twice the earnings of a hod-carrier, plus twenty-five per cent for professional profit? What would farmers and stock raisers say of a law which should forbid their selling a specially promising colt, or a bull of superior stock and breeding, for more than twice the average price of animals of the kind, with twenty-five per cent added for breeder's profit? What would any man in any profession, business, or art say of a law arbitrarily limiting the profit he might make from his genius, or skill, or patient labor, or fortunate investments of any sort? If such interference would be unjust in the case of the farmer, the miner, the professional man, the artist, or any other, it is not less an injustice to the inventor.

The attempt to limit arbitrarily the inventor's profit in his invention would be bad policy in that it would remove the great incentive to invention, and still worse, it would tend strongly to suppress useful inventions should such be stumbled upon. If men were deprived of the possible hope of making a rapid fortune through successful invention they would not toil on year after year, in poverty may be, to achieve some grand result. Besides the more profitable the invention to the inventor, the greater generally is its value to the community, in the long run if not immediately. But this law would make a poor invention or slight improvement more profitable to the inventor than a great one. The greater the economy effected by an invention the smaller, under such a law, would be the inventor's percent age of profit, thus placing an indirect penalty upon successful invention as marked as the penalty for thrift upon the worst managed Irish estate. Said a tourist to a wretched cottager at the door of his hovel, "Why don't you mend your roof and make your place more tidy and comfortable and wholesome?" "What!" was the reply, "and have the landlord raise me rint!"

The law as proposed would be futile: first, because of its vagueness; second, because, though it attempts to limit the profit of the inventor and maker of patented articles, it in no way touches the profit of the dealer.

The bill limits the rental of patented articles and processes to two and a half times their cost, but it does not say how that cost is to be determined or for what period the rental is to be paid. Some things are rented by the hour, some by the day, some by the year. For what length of time is the prescribed rental to be charged? Again, by strict and skillful economy a manufacturing inventor may turn out an article at the cost say of one dollar. His royalty and profit would then be limited to a dollar and a half. Suppose he chooses not to be so very skillful, but makes the cost of production two dollars, increasing his legal royalty and profit to three dollars. How could Mr. Converse help himself? And how many radically novel and economical processes would the public ever hear of under such a rule?

But suppose the inventor or manufacturer too honest or too stupid to study his own interest in that way, what is to hinder the jobber from doubling, trebling, or increasing a hundred fold the price of the patented article, irrespective of the maker's profit, except the limit of price which the public desire or need determines? If an article is worth ten dollars a year to the user, and there is no cheaper substitute, that fact will ultimately fix its price whatever may be its original cost. To arbitrarily limit the profit of the inventor and manufacturer, therefore, simply takes what properly belongs to them and gives it to the go-between, who has certainly done nothing to justify such a discrimination in his favor.

Though these remarks have been so far extended, we feel that we have but barely touched upon or hinted at the more obvious objections to the law proposed in this bill. There is scarcely a field of productive effort in which its injustice and unwisdom would not work mischief if it could be enforced, and the attempt to enforce it would be scarcely less mischievous.

"HOW STEEL HARDENS."

The above is the title of a paper read before a recent meeting at Pittsburg, of the Engineers Association of Western Pennsylvania, by its President, Mr. William Metcalf, who is also a prominent steel manufacturer of Pittsburg. The gentleman has for years expended thought and time upon the topic, assisted in the chemical bearings of the subject by Professor Langley, of Ann Arbor, Mich. The paper awakened a deep interest among the iron and steel men of Pittsburg, and is an exhaustive treatise. The conclusions arrived at by Mr. Metcalf and Mr. Langley are embodied in the concluding portion of the paper, in which the authors express the opinion that it has been clearly shown:

First—That a good soft heat is safe to use, if steel be immediately and thoroughly worked. It is a fact that good steel will endure more pounding than any iron.

Second.—If steel be left long in the fire it will lose its steely nature and grain, and assume the nature of cast iron. Steel should never be kept hot any longer than is necessary for the work to be done.

Third.—Steel is entirely mercurial under the action of heat, and a careful study of the tables will show that there must, of necessity, be an injurious internal strain created whenever two or more parts of the same piece are subjected to different temperatures.

Fourth.—It follows that when steel has been subjected to heat not absolutely uniform over the whole mass, careful annealing should be resorted to.

Fifth.—As the change of volume, due to a varied degree of heat, increases directly and rapidly with the quantity of carbon present, therefore high steel is more liable to dangerous internal strains than low steel, and great care should be exercised in the use of high steel.

Sixth.—Hot steel should always be put in a perfectly dry place of even temperature while cooling. A wet place in the floor might be sufficient to cause serious injury.

Seventh.—Never let any one mislead you with the statement that his steel possesses a peculiar property which enables it to be "restored" after being burned. No more should you waste any money on nostrums for "restoring" burned steel. We have shown how to restore "overheated" steel. For burned steel, which is oxidized steel, there is only one way of restoration, and that is, through the knubbling fire or the blast furnace. Overheating and restoring should only be allowable for the purpose of experiment. The process is one of disintegration, and is always injurious.

Eighth.—Be careful not to overdo the annealing process; if carried too far, it does great harm, and it is one of the commonest modes of destruction which the steel maker meets in his daily troubles. It is hard to induce the average worker in steel to believe that very little annealing is necessary, and that a very little is really more efficacious than a great deal.

Finally, it is obvious that, as steel is governed by certain and invariable laws in all of the changes mentioned, which laws are not yet as clearly defined as they should be, nor as they will be; nevertheless, the fact that there are such laws, should give us confidence in the use of the material, because we may be sure of reaching reliable results by the proper observance of these laws. Therefore there is no good reason why engineers should be afraid to use steel if they manipulate it intelligently. Now, if we have wandered over a wide range in answer to the simple question, "Why does steel harden?" it was necessary to have looked at many facts before we could have an intelligent opinion of many theories; and if any are in doubt as to what is the correct answer to this momentous question, we only say that we are all "in the same boat," for if you do not know, neither do we."

APPROXIMATE ECONOMY OF GAS AND ELECTRIC LIGHTING.

It is not in every place or position that the electric light can be employed in lieu of gas; but under some circumstances, for example, in spacious apartments, where large numbers of gas lights are used, the electrical method of lighting may now be adopted with satisfactory success. Under such conditions, and with gas costing the excessively high prices that we are accustomed to pay, the superior economy of electricity over gas has been conclusively settled on this side of the Atlantic. We might cite various examples, but for our present purpose one will be enough, to wit, the Riverside Worsted Mills, Providence, R. I., where the Brush electric lights have been in regular use for about one year past—long enough to determine their actual expenses and merits.

In one portion of the above mills 1,000 gas lights were used, each of 15 candles intensity, yielding an aggregate of 15,000 candles, and costing $12.25 per hour to run them, or 0·82 of a cent per candle per hour.

We are not informed as to the exact cost of the gas per 1,000 cubic feet, but we figure it to be $2.45.

In lieu of the above 1,000 gas lights 80 electric lights were substituted, each of 2,000 candles intensity, yielding an aggregate of 160,000 candles, and costing 80 cents per hour to run them, or 0·05 of a cent per candle per hour.

If we have not been misinformed as to the above estimates of costs and intensities, it would appear that gas lighting, at the mills named, was at least sixteen times more costly than electric lighting, quantity of light produced being considered.

It may not be uninteresting briefly to compare the probable economies of Mr. Edison's new system of lighting with the foregoing results.

Mr. Edison's method has, to be sure, as yet only reached the stage of experiments. But it must be remembered that his trials have been made on an extensive scale, with full-sized electrical machines and apparatus, expressly with a view to show and determine what the practical introduction of the invention, wherever used, would accomplish. We have his authority for saying that the generous sum of one hundred thousand dollars in cash was placed at his free disposal, by his associates, to be used as he saw fit for these grand experimental demonstrations.

In a word, Mr. Edison's plan is to furnish small electrical lamps, each having the intensity, he tells us, of an ordinary gas light of fifteen candles, burning five cubic feet of gas per hour. He states that he gets ten lamps, or 150 candles, of light per hour per horse-power of engine; and that each of his new electrical machines furnishes 750 candles of light and requires five horse-power to drive it.

Applying the Edison system to the Riverside Mills and to the replacement of the 1,000 gas lights, we have the following approximate results:

Number of Edison lamps required, 1,000; number of Edison machines required to run the lamps, 20; engine power needed, 100 h. p. Approximate cost of the Edison plant, $16,000. Approximate cost of running the same, delivering 15,000 candles of light per hour, including 6 per cent. interest on the plant, $1.66 per hour, or 0·11 of a cent per candle per hour. This estimate allows no royalty to the owners of the patents. Thus the approximate cost of gas lights at the Riverside Mills is seven and a half times more than the same quantity of light would be under the Edison system. And the cost of the Edison system would, approximately, be two and one-fifth times more than the cost of the same quantity of electrical light as delivered by the present Brush machines.

Side by side the fractions stand as follows:

Approximate costs of lighting per candle per hour:

Gas Lights.	Edison Lights.	Brush Lights.
$\frac{82}{100}$ of a cent.	$\frac{11}{100}$ of a cent.	$\frac{5}{100}$ of a cent.

THE CORUNDUM MINES OF NORTH CAROLINA.

The name "corundum" is applied to all crystallized alumina. It is the hardest mineral in the world, except the diamond, and when in the crystalline form and transparent, constitutes the Oriental gems, the sapphire, ruby, emerald, topaz, etc., which are of great value, some even exceeding the diamond, because they are more rare. It is used for abrasive purposes, but as yet a sufficient quantity has never been found in this country to take the place of emery. It is much harder than emery, performing the work in less time.

Corundum occurs in the great chrysolite belt extending from the southern part of Virginia to middle Alabama, passing in a southwesterly direction through the mountainous portion of North Carolina. In the southwestern counties in the Nantahala range of mountains (one of the spurs of the Blue Ridge), and lying on either side of Buck Creek (a tributary of the Tennessee), at an elevation of from three to four thousand feet in the so-called Cullakenee corundum mine, which has been considered the largest deposit of corundum in this country. It covers an area of three hundred acres. This mine was purchased in April, 1879, by Herman Behr & Co., and has been worked since May, with what success is not reported.

In Macon county, N. C., on the western slope of the Blue Ridge, at an elevation of about twenty-five hundred feet, is Corundum Hill, formerly known as Cullasagee mine. This mine was discovered in 1872; it was afterwards purchased by E. B. Ward, and worked for eighteen months by Col. C. W. Jenks, of Boston. Rumor says that gems of exceeding great value were taken out. In July, 1878, this mine was purchased by Dr. H. S. Lucas, for the Hampden Emery Co., of Chester, Mass. They commenced mining August 20th, and up to the present time have taken out two hundred tons of corundum; also, in washing some of the dumps left there when worked by Col. Jenks, were found many fragments of the Oriental gem, perfectly transparent and of very great brilliancy. Among these is an emerald weighing 30½ carats, and several rubies of the finest color.

In the eastern part of Jackson county, N. C., at the foot of one of the highest peaks of the Blue Ridge, is what is termed the Hog Back mine. This mine was operated for a limited season by the Hampden Emery Co.

Northwest of the Pigeon, in Heywood county, N. C., is still another deposit of corundum, called the Presley mine, which has been worked since one year ago last March.

In Madison and near the Buncombe county line, in the same State, is an outcropping of chrysolite, carrying corundum, which covers an area of seventy-five acres, and has been worked for the Hampden Emery Co. for the past season.

Deposits of corundum are also found in South Carolina, Georgia, and Alabama, notices of which we intend to present hereafter.

WHY THE THUNDERER'S GUN BURST.

Our readers will remember that about a year ago a 38-ton gun on board the British ironclad Thunderer burst, killing a number of men and wounding many more. A committee, appointed to investigate the disaster, came to the conclusion that the explosion was caused by a double charge. The gun, having missed fire when loaded with a battering charge (a 700 pound projectile and 110 pounds of powder), was again loaded with a full charge, and fired with both of the charges and the projectiles in the gun at the same time. This decision having been seriously questioned, the government ordered an experimental test by loading and firing the sister gun in the manner alleged. The test was made at the proof butts adjoining the Royal Arsenal at Woolwich, February 3. The second 38-ton gun was loaded and fired with a double charge of 80 and 110 pounds of powder, one 600 pound shell and one 700 pound Palliser projectile. The gun burst as its fellow did on board the Thunderer, thus justifying the opinion of the committee of investigation as to the cause of that disaster. The muzzle of the gun and the projectiles were buried in the sand at the proof butts. The remainder of the gun, with the exception of its base, was blown to atoms.

ARTIFICIAL ICE SKATING RINK, NEW YORK.

Among the new structures lately erected in this city is a skating rink, occupying the westerly portion of the square at the junction of Madison avenue, 58th and 59th streets. The building is of brick. The central portion of the inner space is occupied by an unbroken sheet of ice two hundred feet long and forty feet wide. Surrounding the ice sheet, and on a higher level, is a spacious gallery for visitors. Altogether the establishment is a place of considerable attraction, especially for skaters; and the present winter has been a particularly fortunate one for the proprietors, for the weather has been so mild here that up to the time of this writing the lakes in Central Park and other places have not been sufficiently frozen for safe skating.

The ice sheet formed in the new rink is produced under the patents of Mr. Thos. L. Rankin, whose various inventions in the manufacture of ice and refrigerating machines have heretofore been noticed by us. We believe he was the first to succeed in artificially producing with economy large permanent sheets of ice for skating rinks. At the new rink in question the ice is formed in the following manner:

A shallow water-tight basin is first prepared, in which a network of ordinary iron pipes are laid, divided into valved sections. Water is admitted to the basin, so as just to cover the pipes. A refrigerating liquid, consisting chiefly of salt water, is introduced within the pipes, and, by means of a steam pump, forced to circulate through the pipes and through a suitable refrigerating apparatus placed at a little distance from the basin. The liquid, in passing through the refrigerating apparatus, is cooled down fifteen or twenty degrees below the freezing point, and this cold liquid, when forced through the network of pipes, soon causes the water in the basin to freeze into a solid sheet. In order to renew the surface of the ice after it has been cut up by the skaters, the surface is swept off and a thin film of fresh water put on the ice by hose pipes. This film soon congeals, and a new, smooth surface is ready for visitors. The renewals are generally made at noon time and between six and seven P.M. The rink is open during the day and evening, and is generally full of visitors and skaters, and forms an interesting addition to the various entertainments of this great city.

Test Trials of Steam Engines.

Among the interesting features of the forthcoming Millers' International Exhibition at Cincinnati, June, 1880, will be a test trial of automatic cut-off steam engines. We publish in this week's SUPPLEMENT the full code of regulations for this trial, as prepared by the Chief Engineer, Mr. John W. Hill, C.E. Every precaution which experience could suggest appears to have been adopted by the engineer in preparing the regulations to render the tests impartial and effective. These trials will doubtless yield much useful and instructive information concerning the latest improvements and economies in steam engineering.

A Belgian Prize.

The yearly prize of $5,000 (25,000 francs) offered for international competition in works of intelligence, by the King of Belgium, will be granted in 1881 to the best treatise on means of improving harbors on low and sandy coasts. Essays for competition must be submitted to the Ministry of the Interior at Brussels, before January 1, 1881. The decision will be made by a jury of seven—three Belgians and four foreigners of different countries. This competition is worthy of the attention of American engineers for its own sake, as well as for the benefits likely to flow therefrom to many of our Atlantic ports, which present problems not unlike those of the ports of Belgium.

Melting Street Snow by Steam.

It has often been proposed to use steam to fuse snow in the streets. A correspondent of *La Nature* endeavors to prove, by a few simple figures, how impracticable this idea is. He finds that every square meter of street covered with a layer 5 c.m. in thickness would require 5,000 calories to fuse the snow on it, and that the locomotive could only fuse, *at the maximum*, the snow covering 54 square meters per hour. With a width of 15 meters this represents a theoretical advance of less than four meters (13 feet) in an hour.

New Ast onomical Instruments.

At a recent meeting of the French Society of Civil Engineers, M. Saubert presented several of the instruments already made, and designs of others, for the great popular observatory which has been projected. A large variety of telescopes of all dimensions, and of new modes of mounting, was exhibited. The total of instruments was about 100; more than 20 have been already made. Among the telescopes planned, one with an object glass one meter in diameter excited much interest. This is intended to project on a screen, before a thousand persons in a hall like that of the Trocadéro, an image of the sun or of the moon with much detail; also planets, groups of stars, double stars, and perhaps even nebulæ. M. Saubert is assisted in his work by several young astronomers.

A New Use for the Telephone.

Hitherto it has been a matter of some difficulty to determine the time of flight of small-arm projectiles, owing to the impossibility of seeing them strike. In a series of experiments made by the U. S. Ordnance Department this difficulty has been overcome by the use of the telephone. The telephone was connected with two Blake transmitters, one placed near the gun, the other in front of and near the target. The time between the report of the gun and sound of the ball upon the target was measured by a stopwatch. The observations, founded on a large number of experiments, never differed more than a quarter or half of a second from each other, the slight delay in starting the watch being neutralized by the delay in stopping it. It was found that the time of transit was affected by the wind, being shortened by a rear and lengthened by a head wind.

Telegraphic Communication with South Africa.

Cape of Good Hope has been brought into telegraphic communication with England by the successful completion of the cable between Aden and Zanzibar. The first messages were transmitted between Queen Victoria, the Sultan of Zanzibar, and the Governor of the South African Colonies, December 25.

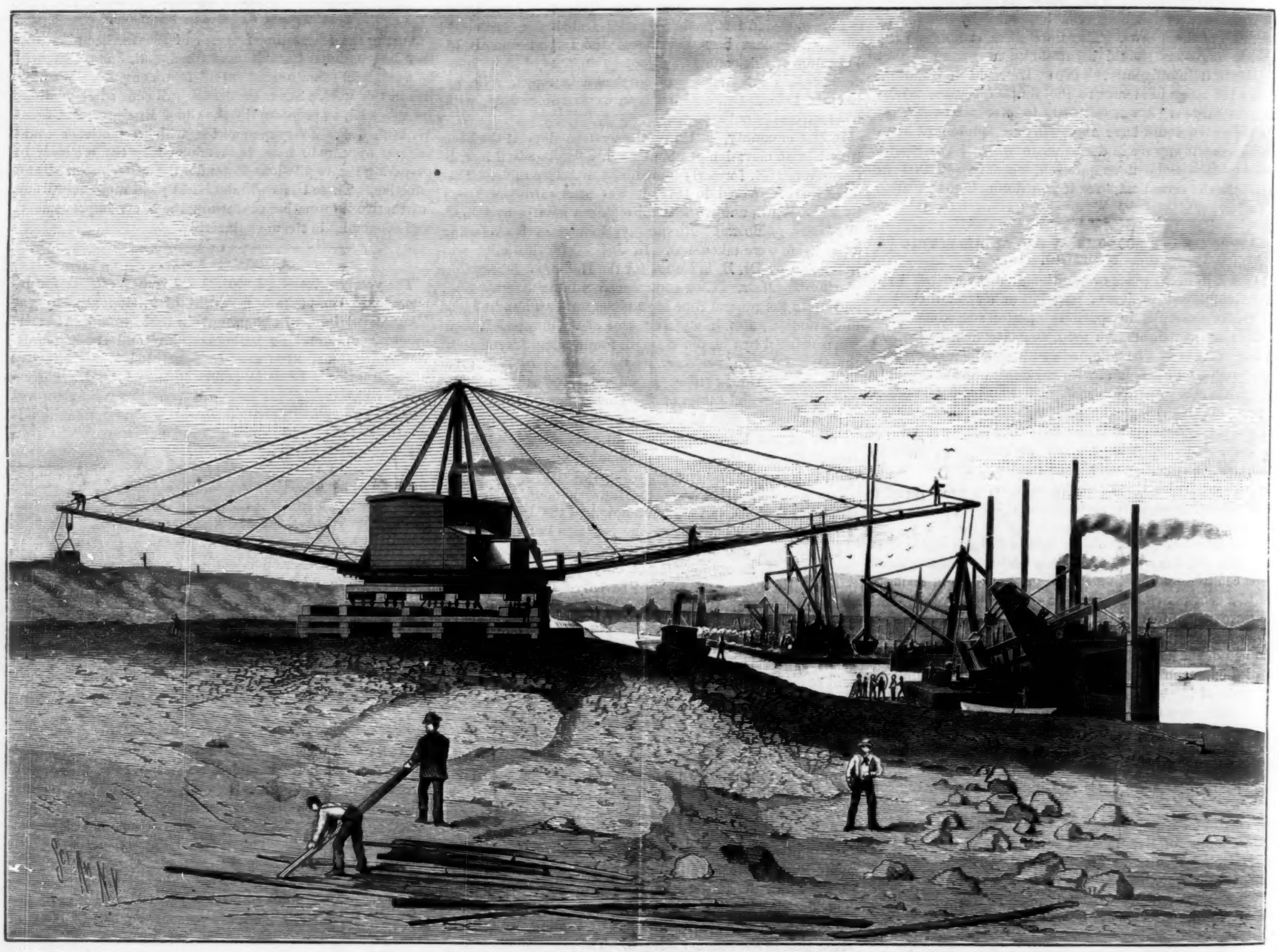
IMPROVED REVOLVING DERRICK.

This important improvement in the economy of hoisting and removing earth, rock, or other material, has now been in use for some two or three years on the work of the inventors, who are contractors on the "Quebec Harbor Improvements." It consists, essentially, of a circular platform mounted upon wheels which run upon a circular track. This circular platform carries two or more booms, arranged symmetrically, and combined with suitable hoisting apparatus for raising material upon one side and moving it to any point within the sweep of the boom. The circular platform of the derrick now in use is forty feet in diameter, with a mast thirty-eight feet high, and booms of one hundred and ten feet each, thereby making the total swing of the derrick two hundred and twenty feet. The revolving machinery consists of a pair of 6 x 10 cylinders, connecting by bevel gearing with a vertical shaft, at the lower end of which is a pinion working with a circular rack of 12 feet diameter. This pinion is held securely in gear by the steadiness of the circular platform upon its track, and is not affected by any slight vertical motion of the platform. The hoisting is done by an additional pair of engines, 8 x 14 cylinders, connecting with two friction drums working independently, thus enabling the operator to hoist and revolve the load simultaneously.

The circular track is laid with steel rails and is firmly supported upon the lower platform, which is of sufficient strength to resist the great weight and strain brought upon any given point. The step or socket at foot of the mast consists of heavy bearing plates with a central orifice adapted to conical rollers upon which the mast rests. The booms are supported upon the platform, the inner end resting in a socket at the foot of the mast. They are suspended by wire ropes from head of the mast and secured against lateral strain by guys connecting with the platform. Obviously the weight of the structure rests mainly upon the circular track, and when any one of the booms is loaded the wheels and the rollers upon which they rest on the loaded side form the support for the said load, and become the fulcrum over which the loaded boom acts as a lever, the whole circular platform and opposite boom serving as counterbalancing weights to hold the platform in place and enable it to securely carry the load.

Heretofore, although derricks have been in common use for hoisting heavy materials and transferring them over short distances, as from the wharf to shipboard and the reverse, the only practical way which has been found for removing heavy masses of earth or other material to any considerable distance has been the laborious and expensive method of carting or wheeling.

By the revolving derrick material can be hoisted to any desired point, and removed horizontally from two to four hundred feet, for it is plain that by increasing the circular platform and elongating the mast the sweep of the booms can be readily extended to the latter distance. The derrick can be worked and moved from point to point either by means of crib-work or piles and ordinary railroad track, or by a suitable float. The present derrick has been used chiefly for removing material directly from a dredge of a working capacity of some 1,200 cubic yards per day, a full load of the dipper or bucket being about 4½ tons, but bowlders weighing over 8 tons have frequently been removed without the slightest injury to any part of the machinery. The working capacity of this derrick may be fairly stated at 50 revolutions per hour.



MOORE & WRIGHT'S REVOLVING DERRICK.

The Science of War.

The "science of war" means something more than it used to, when war was merely the opposing of brute force with brute force. An illustration of what it now implies is furnished by the *Avenir Militaire*, in an account of the apparatus employed in French gunnery practice, for the translation of which we are indebted to the *Iron Age*.

The force and velocity of the wind is first measured by an anemometer. Then the weight of the atmosphere must be determined by a barometer, because sights adjusted to a certain barometric pressure must be changed if the pressure varies. Next a hygrometer is used to determine the amount of moisture in the air, as this determines to some extent the resistance encountered by a projectile in its flight. If the object aimed at is out of sight, the use of the plane table or planchette is necessary. Then the gunner must employ the telemeter to measure the distance of the object to be struck, and when all preparations are made he consults the thermometer to see what the temperature is, since allowance must be made for contraction and expansion of the metallic sights. He is then ready to blaze away, but how many instruments he needs to determine the course of his projectile and the effect of his shot we do not know.

With such refinements in gunnery, we should think it would not much longer be necessary to kill men, although it is probable that some mortality will result from trifling errors in calculation, or because the soldiers shot at will not stand still while the gunner is calculating his aim. All that is desired by the most bloodthirsty enemy is to place as many as possible of the opposing force *hors de combat;* then scientific surgery comes in, and it will soon be that, if enough pieces can be collected, the worst wounded men can be put together and patched up so as to be almost as good as new in a few months. It is at least satisfactory to know that the greater the progress in scientific warfare and in the improvement of arms, the fewer are killed and wounded in battle. In the days when opposing forces used to stand at arm's length and hack each other to pieces with short swords and axes, very little was known about the science of war; but more men were often killed in a day than could now be brought into the field by any but a first-class military power. Perhaps it will come some day that, instead of making war, the powers at variance will merely send each other a statement of their military preparations, whereat the weaker power will make the necessary concessions.

Influence of Watering on the Germination of Seed.

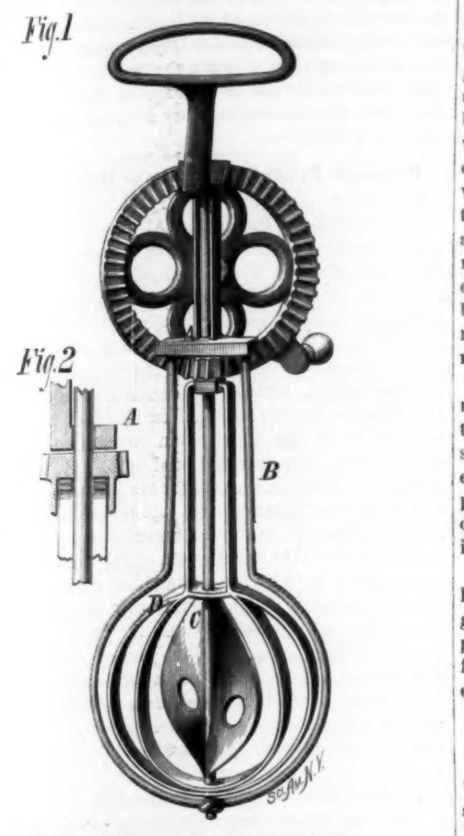
In his researches upon this subject, Professor Just has found that seeds which have been thoroughly dried for a long time can be raised to a temperature of 120° C. without losing their germinative power, if only they be *slowly* exposed to moisture. But if their thoroughly dried-up protoplasma is suddenly drenched with water they are killed, in just the same manner as frozen plants are killed if too suddenly thawed. To favor the rapid introduction of water in the course of his experiment, Professor Just bored holes in grains of wheat, an operation which under ordinary circumstances does not affect the germinative power of more than 15 or 20 per cent of the grain thus treated. These seeds were then carefully dried at 30° to 40° C. over sulphuric acid or chloride of calcium, and one portion of them slowly moistened, while the other was quickly impregnated with water. Of the latter only from 10 to 15 per cent retained their germinative power, while of the former it was destroyed in only about the same proportion of cases.

IT is a curious fact that in some lines of manufactures the Canadians are beating the Yankees in economy of production. For example, the Waterous Manufacturing Company, of Brantford, Ontario, have, we learn, for some time past been delivering steam engines in Bremen at less prices than the American makers can put them down there.

BLACKING.—Mix intimately 1 pound of molasses, 1 pound of best bone-black in *very* fine powder, and ¼ pound olive oil; then add ¼ pound sulphuric acid, previously diluted with ¾ pound water. The whole is allowed to stand for three hours or longer, and afterward as much water is added as is necessary to give it the proper consistence.

NEW EGG BEATER.

The accompanying engraving shows an improved egg beater recently patented by Mr. Harry C. Mann, of 4850 Cherry St., Frankford P. O. While the egg beater in some respects resembles others in market, it differs from them in important particulars. It is so simple and well designed that the parts may be easily made and readily put together without special machinery or skilled labor. The essential feature of this invention is the perforated spiral



MANN'S IMPROVED EGG BEATER.

disk secured to the central spindle and forming a screw or propeller-shaped blade, which renders the device very efficient. The egg beater is shown in perspective in Fig. 1, and Fig. 2 is a detail view of the lower spindle bearing, showing connection of the lower pinion with the beater, D.

On the lower end of the handle there is a cross piece, to which the ends of the wire, B, are secured. The center of the wire, B, is formed into a coil or eye forming a bearing for the lower end of the spindle, C. The latter has near its lower end a perforated metallic disk, and at the top a pinion which is engaged by the driving wheel. The perforated disk is twisted, forming a propeller wheel, which, together with the curved strip, D, rapidly and thoroughly beat the eggs. The bent strip, D, is connected with a pinion placed loosely on the spindle, C, and meshes into the drive wheel. By this arrangement the two movable parts are driven in opposite directions.

NEW AGRICULTURAL ENGINE.

The annexed engraving represents a very compact and simple agricultural engine made by G. Westinghouse & Co., of Schenectady, N.Y. This engine, in its general design and in the details of its construction, seems well adapted to work for which it is intended. It is very light, weighing complete but 3,800 lb., and its economy in the consumption of fuel is worthy of special mention, as it consumes only 500 lbs. of coal per day when working 10 horse power.

This engine has an upright boiler shell, but it is not open to the objections usually brought against upright boilers. The tubes in this boiler are horizontal, and so arranged that they are filled with water so that a constant circulation is maintained in them. The difference between this and boilers having vertical tubes is material; the danger of burnt tubes and crown sheets is avoided, and by reason of the small volume of water contained in the tubes, steam is made rapidly. The circulation of the water in the tubes tends to keep them free from sediment, and they do not become incrusted with scale. The boiler may be easily taken apart at the junction of the upper shell and fire box; and this being done, the tubes are all exposed and the inner surface of the boiler placed within reach for cleaning or repairs.

The boiler is surrounded with a sheet iron casing, leaving a space between it and the boiler shell. This space acts as a flue for conducting the waste heat from the fire box, and affords complete protection against condensation, and in addition to this it receives and extinguishes all sparks coming from the fire. No screen is required in the stack, and the annoyance resulting from screens becoming clogged, and the temptation to remove or open them in order that sufficient draught be obtained, are avoided.

The manner in which the engine and boiler are connected is clearly shown in our engraving. The bed or frame contains the heater, and is securely bolted to the fire box portion of the boiler. The engine has its cylinder, steam chest, guides, and main boxes all in one solid casting, and having all the work relating to the lining of the cylinder and main bearings done from a single position, absolute truth of all working parts is assured. The engine and its bed being connected with the lower part of the boiler, the greatest weight is below the center, and takes away all danger of turning over while on difficult roads. All parts of the engine are accessible from the ground and can be seen by the operator. Every desirable appliance for rendering the engine efficient, durable and convenient has been supplied. A blower and variable exhaust nozzle furnish means for regulating the force of the draught, and for making steam rapidly when required.

An ordinary team can handle this engine easily over common roads even with a full supply of water. Economy in the use of fuel and water is an important point to be considered by both the owner of an engine and by those who employ him, for there are but few places where fuel is too plenty, and in many places water is scarce or has to be drawn so far that it becomes important to make all the saving possible.

Systematic and thorough tests made with this engine have shown that less than 500 lb. of good coal and 350 gallons of water were sufficient to make steam for ten horse power, ten hours, as against 800 to 1,000 lb. of coal and from 400 to 450 gallons of water required by the average engine to accomplish the same work.

THE NEW WESTINGHOUSE AGRICULTURAL ENGINE.

Warmth and Energy.

In ancient times, energy of mind and strength of body were supposed to be the effects of warmth, while depression of spirits and bodily weakness were ascribed to cold. Modern science has explained and modified these theories concerning the production of physical and psychical force, but in the main it has confirmed the principle of causation. In a general sense, it may be said that animal heat, when duly generated within normal limits, is the concomitant of vigor. Practically, therefore, warmth is to be sought and cold avoided; but with this qualification, that the heat must be elicited by organic processes going on within the body, and not borrowed from without. The chief, if not the only use of wraps and "warm" surroundings is to avoid the loss of animal heat by abstraction. It is neither scientific nor hygienic, in any true sense, to trust to external sources of supply for the warmth we require to live well, happily, and usefully. The food is more than the raiment, and those who desire to help the poor and melancholy over their "dead points" in the course of life should be chiefly anxious to feed them well and sufficiently. So in the management of self—to live well is to feed appropriately. Stimulants do not give strength, because they cannot add to the normal and healthy sources of animal heat. Nutriment is the only true fuel.—*Lancet.*

LIFE PRESERVER EXHIBITOR.

Some time since we pointed out the necessity of making known the whereabouts of life preservers on board vessels, and of informing the public how to apply them so that in cases of accident they may be readily found and properly applied. Mr. C. C. Delhommer, of Carencro, Lafayette Parish, La., in response to the suggestion, devised and patented the exhibitor shown in the annexed engraving. It consists of a water tank made in the form of a human figure, having applied to it a life preserver in the position

DELHOMMER'S LIFE PRESERVER EXHIBITOR.

in which it should be worn. The water tank is an indispensable article on the vessel, and as it must of necessity be frequently visited by the passengers, the manner of applying the life preserver will be often seen, and the public will soon gain an accurate idea of the proper way of putting them on.

Most vessels have life preservers conspicuously labeled so that they may be readily found, but there are many people who would be entirely at a loss to know just how to apply them without some sort of instruction. The device shown in the engraving is a mute but efficient teacher ever on duty and within sight of the passengers. We are informed that Mr. Delhommer has taken steps to bring this invention to the notice of the proper authorities. Certainly too much cannot be done in this direction.

AGRICULTURAL INVENTIONS.

Mr. Charles A. King, of Cheshire, Ohio, has patented an improved machine for digging potatoes, which is so constructed as to dig the potatoes, separate them from dirt, clods, etc., and deposit them in a box or basket.

Mr. William R. Iles, of Fairmount, Ill., has invented an attachment to corn planters for dropping and marking the corn in perfect check row. The attachment has more especial adaptation to that form of corn planter in which two thin blades or runners are arranged on each side of the tongue so as to rest upon and run on the ground, which runners or blades are connected to a suitable framework and terminate in the rear in vertical spouts extending from the seed boxes, from which seed boxes and down which spouts the corn is dropped by the reciprocation of a slide extending from one to the other of said boxes.

Mr. John W. Fields, of Sherman, Texas, has invented a device for supplying water and air to the face and land side of a mould board, to prevent the earth from adhering to them. It consists in perforating the mould board and land side with small holes, and attaching to the back of the mould board a water reservoir and a piston and pump or other device for forcing water and air through the perforations, so as to lubricate the faces of the plow, and thus prevent the adhesion thereto of earth.

Mr. Auguste N. Verdery, of Atlanta, Ga., has patented an effective machine for thrashing the heads of standing grain and cleaning the grain by a blast produced by the thrashing mechanism. It consists in combining with a reel and a case, having mouth or inlet for the grain in the straw, a cylinder having teeth adapted to give a shear cut and gather the heads inwardly toward the middle of the cylinder.

Mr. James B. Taylor, of West Hurley, N. Y., has patented an improved machine for digging potatoes, and which may also be used for loosening the soil and destroying grass and weeds between the rows.

Mr. Joseph Lane, of Chicago, Ill., has patented a rolling colter for plows, which consists in combining with a mould board plow a rolling coulter made dished or concaved on the mould board side, whereby the straw, grass, and manure are not only cut, but are turned over so that they will be completely covered by the plow.

Mr. Jesse A. Kirkpatrick, of Cartersville, Ga., has patented a seed planter adapted for planting cotton seed and all kinds of smooth seed, such as peas, beans, corn, wheat, etc. The invention consists in the combination and arrangement of parts, which cannot be clearly described without engravings.

Correspondence.

On the so-called "Crystallization of Canada Balsam" and how to Make Ornamental Picture Frames.

To the Editor of the Scientific American:

In your last issue you publish an article by Mr. Geo. M. Hopkins, who, writing on the above in answer to a statement made by Professor Barker, holds that he does not "think that the beautiful arborescent forms are anything more than cohesion figures," in which he is right. Some years ago, when I was employed in a picture frame factory, one of the mechanics, a Mr. Jackson, who was working there with me, said he knew a German who used to make picture frames from glass, the process of which he tried to keep a secret, but which was captured from him by Mr. Jackson; and as I think it might be of some amusement and practical utility for some of your numerous readers if you publish the same, I will give you the process:

After having agreed upon the length and width of the frame, get four strips of glass, and after having cleaned them take one of these strips and pour some pure asphaltum, which has been dissolved in turpentine by heat, on the entire length of the strip; and if now you take another of the strips and lay it on the asphaltum, and then press the two strips together with your fingers, you can produce as many "ferns and cacti" as you please by holding the strips between you and the light. After having produced some of these "ferns and cacti," which you wish to retain, apply a knife between one of the ends of the strips and gently pull them apart and lay them aside, so that they may become hard or dry; now proceed with the remaining two strips in the same manner as described, care being taken to match the "ferns or cacti" as near as possible to the one on the two first strips. After having become hard or dry, apply any color or colors that you may fancy on the asphaltum, and let this also dry; then apply some thin composition smoothly with a knife over the colored parts of the strips, this composition being the same that they employ for ornaments for picture frames, etc. When this has also become hard, cut the ends of the strips with a diamond to the proper angle and length, and glue them on four strips of wood which are also of the proper angle and length, and nail them together; the sides of this frame may then be incased with gold or other mouldings.

F. E. Forster.

New York, February, 1880.

Fire from Steam Heating Pipes.

To the Editor of the Scientific American:

In respect to fire from steam heating pipes, the letter of Mr. Wm. J. Baldwin may lead your readers into very grave danger unless facts are stated that have come to the knowledge of the officers of this company.

It is alleged that "no one imagines they can light a stick against a boiling kettle, temperature 212°," which is perfectly true; but we have a specimen of wood reduced to charcoal by the heat of boiling water. It constituted a part of an open boiling kier in a bleachery. By long use the inside of this kier had become rough, nails were driven in half their length and cement put on, held by the nails, the heads of course being covered. In less than twelve months the heat carried into the wood by the nails carbonized it.

That charcoal may be inflamed by steam pipe has been proved to us by the fact that one of our members packed a steam pipe across a yard in a wooden box, filling in with fine charcoal as a good non-conductor of heat. Within twelve hours the charcoal was in a state of intense combustion.

A steam pipe was carried through a sill in a new hotel in Woonsocket, R. I., in contact with the wood; in less than twelve months combustion ensued. I have a partially burnt section of this sill, set up with the pipe as it was arranged.

We also have a portion of a factory beam partly burned by contact with steam pipe. Our vice-president found a steam pipe in contact with a floor; the floor was hot at the time it was cut away, and it proved that the beam had been on fire and the fire had gone out for want of oxygen.

We could give several more examples, but these will suffice. We assume that ignition takes place from slow chemical reaction after the wood has become carbonized, and under certain conditions favorable thereto, which may not often occur, but which have yet occurred so often within our knowledge as to make contact of wood with steam heating pipes one of the grave dangers which cannot be tolerated anywhere.

We have within our knowledge numerous examples of the lint of oiled wool, workmen's overalls, and other substances being set on fire by contact with steam heating pipes.

Edward Atkinson,
President Boston Manufacturers' Mutual Fire Insurance Co.

How to Make Tight Tarred Paper Roofs.

Have the lower layer of paper that comes next to the boards without tar or dressing of any kind (*plain paper*), then over that three layers of tarred paper. When the tarred paper is laid on the boards of the roof it adheres firmly to the boards, and when they come to shrink (as they always do) the paper is torn at the joints between the boards, especially if wide lumber is used the fracture is greater. Plain paper does not adhere to the boards, and they are allowed to shrink or expand without damaging the roof. I have tried it and know that a roof put on in this way will remain tight more than twice as long as when the tarred paper is laid next to the boards, besides it entirely prevents the dripping of tar through the cracks of the roof in hot weather. The extra expense is a mere trifle, not 25 cents each square of 100 feet.

J. E. Emerson.

Beaver Falls, Pa.

Captive Light.

A little reflection will show that if a means could be found for storing up light, as heat or electricity can be stored, the invention would be of almost infinite application. To discover means of this kind has been the aim of an English chemist, Mr. W. H. Balmain, formerly of University College, London, and latterly manufacturing chemist of St. Helens, Lancashire, for a period extending over forty years, and the results of his researches were protected in a patent No. 4,152, 1877, for "luminous paint." It is known that there are certain earths, such as the sulphides of lime and baryta, and some sorts of sea shell, which, on being exposed to the light for a time, become luminous in the dark, and apparently give out again the light which they have absorbed. Mr. Balmain's idea was to compound a paint of these substances which could be applied to the windows of rooms, the walls of streets, buoys, notices, clock faces, and a thousand other articles which require to be seen in the dark, so as to render them self-luminous. Owing, however, to the health of the inventor breaking down, no practical issues came of his invention until quite recently, when it was taken up in a spirited fashion by Messrs. Ihlee & Horne, of 31 Aldermanbury, London. A pioneer company has been formed to work the patent, and there is now an eager demand for the mysterious illuminant.

The exact nature of the luminous ingredient of the paint is kept a secret, but it is said to be wholly extracted from the common chalk of our cliffs. Probably it is the sulphide of calcium, and is prepared by mixing lime and sulphur in certain proportions. The paint can be made with oil or other transparent liquid, according to the purpose for which it is designed. The physical nature of the storing process appears to be that the waves of light breaking upon the molecules of the sensitive salt start them into vibration, and this vibration continuing long after the motive light is withdrawn, sets up a succession of ether waves which affect the eye as light, much in the same way as the blow of a bell clapper gives rise to waves of sound. A sensitive surface of the paint exposed to daylight, or the more powerful beams of the magnesium wire or electric arc for a sufficient length of time, will continue to emit light for four or five hours after. Of course the "stored" light grows fainter as the time grows longer.

We have made several experiments with a specimen of the luminous paint supplied us by Messrs. Ihlee & Horne on a piece of cardboard. After exposure to the sunlight of a window for a few minutes when taken into a dark place it is seen to glow with a violet luster, which is whiter as the darkness increases, or according as the exposure is lengthened. An amusing optical delusion can be performed with it. A half crown is placed on the painted surface before it is exposed to the light and kept there the whole time; when the latter is taken into the dark room or closet, the coin is withdrawn. Nevertheless its position is distinctly marked by a black disk surrounded by the luminous field of the paint, and it is easy to make any unsuspecting individual mistake the sham shadow for the substance. We call it a sham shadow because it is really the ghost of a shadow, that is, a shadow which exists after the body which occasioned it has disappeared.

Much interest has recently been excited in the product, and many applications of it are proposed. Clocks with dials rendered self-luminous in this way have been some time since introduced by another maker from France; but we understand that a royalty is paid on these to the proprietors of the English patent. The Lords of the Admiralty have been making experiments with it in a darkened room at Whitehall, and have expressed themselves in favor of it for lighting up the compartments of ironclads, or for the powder magazines; and two compartments of H.M.S. Comus have been ordered to be painted with it. For life belts and buoys, it will of course be an acquisition in rendering them visible by night. A lantern capable of enabling a person to read or work in the dark can be made by framing a few square feet of painted surface; and the superintendent of the West India Docks has ordered lanterns for use in their dangerous spirit vaults. The virtues of these lanterns in explosive mines, petroleum stores, and cellars, are too obvious to be dwelt upon. Mr. Towers, who has just supplied the German Navy with his speed indicators, and is now engaged in adapting them also to several English war vessels, notably H.M.S. Northampton, has decided to have the dials of his apparatus illuminated in this way so as to enable seamen on the darkest night to read the index. Mr. Hollingshead, the enterprising manager of the Gayety Theater, is in treaty to secure the sole right to apply the paint in the production of theatrical effects; and it is probable that the process will soon come into conspicuous use as a medium for advertisements.—*Engineering.*

Professor Tyndall's Christmas Holiday Lectures.

On the 8th January Prof. Tyndall, D.C.L., F.R.S., delivered at the Royal Institution, Albemarle street, Piccadilly, the last of this year's Christmas course of "Six Lectures for Boys and Girls on Water and Air." As the lecturer explained at the outset, he confined his attention in what he said of air to its physical properties, and had no intention of entering upon its chemical composition and relations. Torricelli's grand demonstration of the existence and weight of the atmosphere, verified by Perrier's experiments, as suggested by his brother-in-law, Pascal, which proved that the mercury fell in the Torricellian tube as the Puy de Dôme was ascended, was soon followed by his invention of the air pump. It had been claimed for the illustrious Robert Boyle that he greatly improved that instrument, and made with it a great number of important experiments. He saw clearly the condition of the lower strata of the atmosphere, pressed upon as they were by the strata above them. He compared the air particles which sustained this pressure to little corpuscular springs, which cause the air to expand when it is relieved from pressure. Five weeks' continued observation showed him the variation in the height of the barometric column, on which we now base our predictions regarding the weather. He made numerous observations on the influence of atmospheric pressure on the boiling point of liquids.

To Hawkshee is generally ascribed the merit of proving, in 1705, that sound cannot pass through an air pump vacuum; but in a letter from Beaconsfield, dated December, 1659, Boyle described an experiment which proved the same thing. The ticking of his watch he found was extinguished in his exhausted receiver. Boyle imagined, and the notion had even been prolonged to our own time, that the strong adhesion together of two smooth surfaces was caused by the pressure of the atmosphere. That this was an error had been proved by a perfectly conclusive experiment which Prof. Tyndall repeated before his audience, as he had already done in the instance of Boyle's most important ones. Two Whitworth planes were placed *in vacuo*, when it needed as great a force to pull them asunder as that requisite in the open air. Boyle examined the influence of atmospheric friction on a vibrating pendulum. He also made experiments with his air pump on living animals. He put flies, bees, caterpillars, snails, birds, mice, and fish under his receiver, and observed the effect upon them of removing the air. Experiments were also made upon dogs, and the result of his labors was "the lifting of his heart in pious gratitude to the Creator for having made the air so admirably subservient to animal life and enjoyment."

In answer to an attack by the philosopher Hobbes, Boyle wrote his "Defense of the Doctrine touching the Spring and Weight of Air," in which he describes "two new experiments touching the measure of the force of the spring of air compressed and dilated." These two experiments establish with the utmost rigor a law which for generations was ascribed to the philosopher Mariotte. In establishing this law, Boyle omits no precaution necessary to insure exactitude. He worked with a bent tube having a short closed arm and a long open one, compressing the air in the short arm by mercury poured into the long one. In five and twenty different experiments he found that the density of the air was exactly proportional to the pressure exerted upon it, or, as Boyle expressed it, that "the pressures and expansions (volumes) are in the reciprocal proportion." He proved this law true for air at pressures less than that of the atmosphere, as well as at pressures greater than that of the atmosphere. The law of Mariotte should therefore unquestionably be called the law of Boyle. Professor Tyndall having explained the bubbling in the ears felt as we climb a mountain, and shown how it may be stopped by swallowing, remarked further how useful Boyle's poetical expression "the spring of air," is in clearing up such experiments as that of the Cartesian diver, the phenomena of Rupert's drops, and the play of such fountains as depend on the pressure of the atmosphere. The fire engine was also worked by the same agency, and upon it depended the action of the hydraulic ram. In illustration of the power of hydraulic pressure, carbonic acid gas was liquefied before the audience. It was further shown that by it Sir Joseph Whitworth's fluid-compressed steel was not only produced but tested, until at last it withstood a pull of more than a hundred tons on the square inch. Hydraulic pressure, combined with the action of glaciers, had even, as was proved by a working model, produced the "parallel roads" at Glen Ray, in the Highlands, which had so much astonished all who had traveled in the Ben Nevis country.—*London Times.*

AMERICAN INDUSTRIES.—No. 31.

THE MANUFACTURE OF SOLID EMERY WHEELS.

The introduction of solid emery wheels has completely revolutionized some branches of industry, not only in the matter of tools and methods employed, but in the economy of production and in improvements in the quality and appearance of articles produced. Every household contains articles which bear evidence of having been improved by the application of solid emery wheels. Take, for example, the various kinds of heaters, stoves, and ranges; their plates are nicely beveled and polished, their doors are well fitted and finished. The almost numberless little implements used in and about the house, the builder's hardware used in the construction of the house, all bear evidences of the utility of the solid emery wheel. There is not a mechanic or artisan that is not in some way benefited by the invention of the solid emery wheel; it cheapens tools, affords a means of sharpening them expeditiously, and in many of its applications supplants lathes, planers, files, and cold chisels, and saves an amount of labor that can scarcely be estimated.

Emery is a granular variety of corundum intimately mixed with hematite or with magnetic iron ore. Corundum is composed almost entirely of alumina, and is closely allied to the ruby and the sapphire; in fact, it is nothing more nor less than an impure variety of sapphire, and if the emery of which the tanite emery wheel is composed, or the wheel itself, be examined with a magnifying glass, the particles will be recognized as sapphire, being as richly blue and translucent as the veritable gem.

The main supply of emery is from Asia Minor, near Ephesus, and the fact that Smyrna is the depot for all the emery obtained in the East gave it the name of Smyrna emery. A great deal of emery is obtained from Naxos and other islands of the Grecian archipelago.

For many years all of the emery rock of the East was taken to England and there manufactured into grains and flour, and was long known under the equally familiar names of "English" and "Smyrna." It is now largely imported into the United States, and the American mills produce crushed, cleaned, and sifted emery equal to the English.

Emery for the manufacture of emery wheels is crushed by rolling or stamping, sifted, and washed. It is in the form of grains, the coarsest being about like split peas, the finest like flour. The several grades of emery are made up into emery wheels by cementing the grains together by some cohesive substance, and pressing the mixture into moulds of suitable form. Shellac and glue were among the first cementitious substances tried, but they were easily affected by heat; the wheels were therefore defective. Various gums and resins have been tried; soluble silicates have been used, and concrete composed of emery and cement has formed the basis of another class of wheels. The important requisite of a good wheel is to combine its elements so that the emery will be thoroughly cemented together with the smallest possible proportion of cohesive substance. In addition to this it must be of uniform density and free from hard or soft spots. It must remain unaffected by the heat generated by its use, and should be free from offensive odors. It should cut freely and rapidly, and not fill up with metallic particles. It should be durable, and above all, it should have sufficient strength to admit of a high velocity without danger of bursting. It is claimed by the Tanite Company that the tanite emery wheel fulfills all these requirements.

Our large front page engraving contains exterior and interior views of the Tanite Company's works at Stroudsburg, Pa.

The tanite solid emery wheels are composed of the purest and best grades of emery and tanite. A portion of the process of manufacture is kept from the public, but enough is revealed to enable us to give the reader a general idea of the mode of manufacture.

Tanite is the invention of T. Dunkin Paret, who has served as President of the Tanite Company for eleven years. The company's motto, "*Ex inutili utilitas*," indicates the utilization of a waste substance.

The crude material from which tanite is made is waste leather scraps, or skivings, as they are called in the trade; the product is a hard, fine-grained, jet-black substance, which may be moulded under a high heat and pressure, and which is capable of receiving a polish equal to that of the best Whitby jet. It was invented as a substitute for vulcanite, and has been used in the manufacture of combs, buttons, jewelry, checkers, dominoes, and a large variety of fancy articles. Its application to the manufacture of solid emery wheels was suggested by Mr. Abijah Wallace, of New York city, an experienced worker in horn, shell, and rubber. Mr. Wallace was, for many years, superintendent for the Tanite Company, and is still a director and stockholder. He recognized the adaptability of tanite to the manufacture of emery wheels, and from that time to this, tanite emery wheels have been slowly improved through a period of thirteen years, until they are now considered as nearly perfect as it is possible to make them.

The factory of the Tanite Company consists of several buildings, spread over considerable ground, and forming the picturesque group shown in the central view in the engraving. The works are situated about two and a half miles from Stroudsburg, Pa., in the town of Monroe, in the middle of a fifty acre farm, through which flows a beautiful stream, the Pocono Creek, furnishing the works with power.

The machinery of the factory is driven by a 42-inch Jonval turbine under a $23\frac{1}{2}$ foot head. In addition to the water power, the works are provided with a steam engine capable of running all of the machinery. A great deal of space is devoted to the manufacture of a large variety of emery grinding machines. The Tanite Company were the first to combine the manufacture of grinding machines and emery wheels, and have for years been advocating the use of solid emery wheels instead of grindstones and files.

They are noted for their enterprise and energy in adapting their machinery and wheels to the wants of different trades and manufactures, and, notwithstanding the fact that their wheels command a higher price in the market than other goods of the same class, their sales are very large, and the reputation of their goods is as excellent as it is worldwide.

The manufacture of the emery wheel is very simple. The first operation being that of mixing the granulated emery with the tanite. This is done in one of the apartments shown in the upper part of the engraving. The mass of emery and tanite is transferred from this room to the press room, where it is placed in moulds and subjected to strong pressure in the hydraulic presses, while it is at the same time heated by steam passing through the jackets of the moulds.

The last operation in the manufacture of the solid emery wheel is that of turning them perfectly true, by means of diamond turning tools in lathes especially adapted to the purpose, and provided with a hood communicating with an exhaust fan for removing the emery dust. After turning all that remains to be done is to apply the labels and pack the wheels preparatory to shipping.

The Tanite Company have offices and warerooms in Liverpool and London, besides carrying a stock of goods in Boston, Chicago, St. Louis, San Francisco, and in many other of the principal cities and towns in the United States. In Canada and Australia these goods have long been well known.

We are informed that after canvassing the matter thoroughly, the Tanite Company have decided to meet a general demand, by introducing at an early day a low priced wheel, at the same time keeping up the quality of their standard goods.

Liability from Sparks.

Some three months since the *Lumberman*, under the above caption, called the attention of its readers to the fact that improperly guarded smoke stacks were an element of danger not only to the surrounding property, but, as well, to the bank account of their proprietors. We at that time, says the above paper, cited the case of McLaren *versus* the Canadian Central Railway as an instance in point. The mills of the plaintiff at Carlton Place, Ont., together with the mill yards, were destroyed by fire caused by sparks from a locomotive belonging to defendants, which, in passing the yards, emitted sparks which were seen to fall and ignite the lumber, and damages to the amount of $140,000 resulted. Upon suit being instituted in the Court of Queen's Bench, a jury rendered a verdict for $212,000, which being largely in excess of the damages claimed by Mr. McLaren, a new trial was granted, which, on change of venue asked by the railway company, has just taken place at Toronto, and damages awarded to the plaintiff of $100,000. The telegraph announcement of the verdict also stated that the case would be appealed, but it was not stated whether by Mr. McLaren upon the ground of insufficiency of the amount, or by the railroad company. Be this as it may, it is another strong assertion of the law that no man has a right to improperly expose his neighbor's property to destruction. The defense of the railroad was mainly upon the point that ordinary care had been taken to provide sufficient spark catchers to the engine, and that they had done all that they could reasonably be expected to do to avert such calamities. The decision indorses the old-time notion that it is not enough to hope that our neighbor will not be injured by us; we must be sure of the fact, and will be liable for all damage resulting from our neglect. Mill men would, in the light of this decision, do well to so arrange their stacks and chimneys that they will not be open to the liability resulting from damage to their own or their neighbors' property. We append the questions submitted by the learned judge for the consideration of the jury, from which our readers will gather an idea of the points upon which the case hinged. We also append the following extract from the charge of Justice Williams, at Buckingham, England, in a case against the London and Northwestern railroad involving the same points, in which the learned judge said:

"It remains to consider what is to be regarded as negligence on the part of the company for the consequences of which they are to be held responsible. The company, in the construction of their engines, are not only bound to employ due care and all due skill for the prevention of mischief accruing to the property of others by the emission of sparks or from any other cause, but they are bound to avail themselves of all the discoveries which science has put within their reach for that purpose, provided they are such as under the circumstances it is reasonable to require the company to adopt."

The questions submitted to the jury in the McLaren case were as follows:

1. How did the fire occur? Was it from sparks or cinders from the locomotive, or some other cause?
2. If you find the fire was caused by this locomotive, did it come from the smoke stack or ash pan?
3. If you find that it came from the smoke stack, was it from any imperfection in the construction of the stack, or from the manner in which it was managed by those in charge of the train?
4. If you find it was from any imperfection of construction, state what the imperfection was.
5. Was the netting too large, or was the bonnet improperly fastened?
6. If you find it was from improper or careless management of the smoke stack, what was the act done imputing to the defendant such improper carelessness?
7. If you find the ash pan or damper were not properly managed, in what respect were they improperly managed?
8. Was the mesh on the bonnet of engine No. 5 composed of a larger size than that used by the Great Western or Northern railway?
9. Were the defendants guilty of neglect in using such a mesh?
10. Was the plaintiff guilty of contributory negligence in piling his lumber so near the track, leaving the shavings about and not having sufficient appliances to extinguish fires?

The jury then retired at four o'clock, and returned at twenty minutes to seven o'clock with a verdict for plaintiff—damages $100,000.

Tea Taster's Occupation.

Dr. C. L. Dana, in an article in the *Medical Record* on tea tasting by brokers and dealers in teas, maintains that it is a healthful occupation, which is not in accordance with the conceived opinion of other writers on the subject. In support of his assertion Dr. Dana reports cases of living men far advanced in life who have followed the business of tea tasting for periods ranging from thirty to forty years without injury to their health. But whether the writer's conclusions are correct or otherwise, the life of a tea taster is a curious one, and the process of examining and deciding upon the qualities of the article is one not generally known.

There are, says Dr. Dana, probably more than a hundred firms engaged in tea tasting in this city. In all of their offices there are large tables with round, revolving tops. A circle of teacups is placed along the edge of these. The tea taster sits down before the display of crockery, and tastes one cup after another, moving the table-top around. In the center of the table is a pair of scales with a silver half dime in one of the balances. One or two large kettles are kept constantly with boiling water in them. When a sample of tea is to be tasted, as much is weighed out as will balance the half dime. This is put in a teacup and the boiling water poured on. The tea taster then stirs up the leaves, lifts them on his spoon, and inhales the aroma. At the same time he generally takes a sip of the infusion, holds it in his mouth for a short time, and then spits it out. Enormous brass cuspadores, holding two or three gallons, receive the tea thus tasted and the contents of the cups that have been examined. On some occasions, when a large amount of tea of a certain kind is to be bought, many samples of this are brought in from different houses. The buyers and sellers sit around the revolving table with the samples made into infusions in the cups before them. These are tasted all around, the "body," fineness, "toastiness," etc., are learnedly discussed, and the poorer specimens discarded. Then those that are left are tasted again and the number further reduced. So it goes on until the article which unites the desired quality and price is obtained.

The skill displayed at these "drawings" is quite remarkable. A tea taster will detect not only the quality of a tea as regards age, strength, flavor, fineness, etc., but he can tell in which of the numerous districts in China the tea was grown. The facts regarding the different samples are sometimes put on the bottom of the cups, where they cannot be seen. The cups are then mixed up, and the infusions tasted again and sorted out simply by their flavors.

A great deal of tea may be tasted before these tea drawings are finished. It is hard to tell the amount that a tea taster takes during a day, for it varies a great deal with the activity of business. Few of the gentlemen whom I asked could give any idea. Sometimes, however, as many as four or five hundred cups are tasted in the day. It is quite the custom to have to be tasting tea steadily for the most of the day, or for hours at a time. Probably an average of two hundred cups a day throughout the year is a low estimate. The poorer kinds of tea are often not sipped at all. But the sense of smell is depended on. Of the better qualities of tea, some is swallowed, and some spit out. Indeed, whenever the tea is taken into the mouth a little of it is swallowed. The tea gets into the system, therefore, in three ways: by inhalation, by absorption through the oral mucous membrane, and by the stomach. More tea is simply taken into the mouth without swallowing than is inhaled alone; but all the tea is inhaled, even if it is tasted also. It is only a small proportion, amounting to not more than two or three cups a day, that is swallowed. A silver five cent piece weighs 1·18 grms. (gr. xviii.) Estimating that an average of two hundred cups of tea are tasted per day, about one-half of a pound would represent the whole amount used.

Japan tea has of late years become by far the most popular variety, and more of it is imported than of all other kinds together. Green tea, on the other hand, is much less extensively used than formerly.

A SOUND and liberal education is the surest pathway to success in all pursuits. Statistics show that the educated man will, on the average, be as far advanced in his career at thirty-five years of age as the uneducated at forty-five or even fifty. Not one out of every ten of uneducated men achieves success.—*J. M. Gregory, Champaign, Ill.*

THE BINARY ABSORPTION SYSTEM OF REFRIGERATION.

A new competitor in the field of artificial refrigeration appears in the binary absorption system invented by Messrs. C. M. Tessié du Motay and Leonard F. Beckwith on the one hand, and Messrs. C. M. Tessié du Motay and Aug. J. Rossi on the other. The accompanying illustration of the apparatus will remind our readers of the Pictet system, an engraving of which appeared in our issue of December 1, 1877.

The aim of the inventors has been to substitute the chemical affinity of two or more volatile substances for each other in place of compression, to effect the liquefaction of the refrigerating agent; and to discover a compound which should possess the refrigerating power of anhydrous sulphurous acid without its objectionable qualities.

Such a liquid they claim to have found in ethylo-sulphurous dioxide, a bland compound of the appearance of water, liquid at ordinary temperatures, non-inflammable, and without corrosive action upon metals even when mixed with water. Under the gas pump the liquid is volatilized, with a great reduction of temperature, the refrigerator being surrounded by a non-congealable liquid, which is used as a freezing mixture.

The least volatile constituent of the ethylo-sulphurous dioxide is liquefied at a few pounds above atmospheric pressure, and then by natural affinity the more volatile element is absorbed. The heat of liquefaction, which is comparatively low, is carried off by water. A marked economy is, therefore, claimed for this process, compared with the use of sulphurous acid alone. When the machine is working the pressure ranges from 13 to 15 pounds, and the water for cooling the combined liquid runs from 1 to 2 gallons a minute for each ton of ice produced in 24 hours. When the machine is at rest the pressure is from 0 to 2 pounds; and when the water for cooling is turned off the pressure is not likely to rise to a dangerous point.

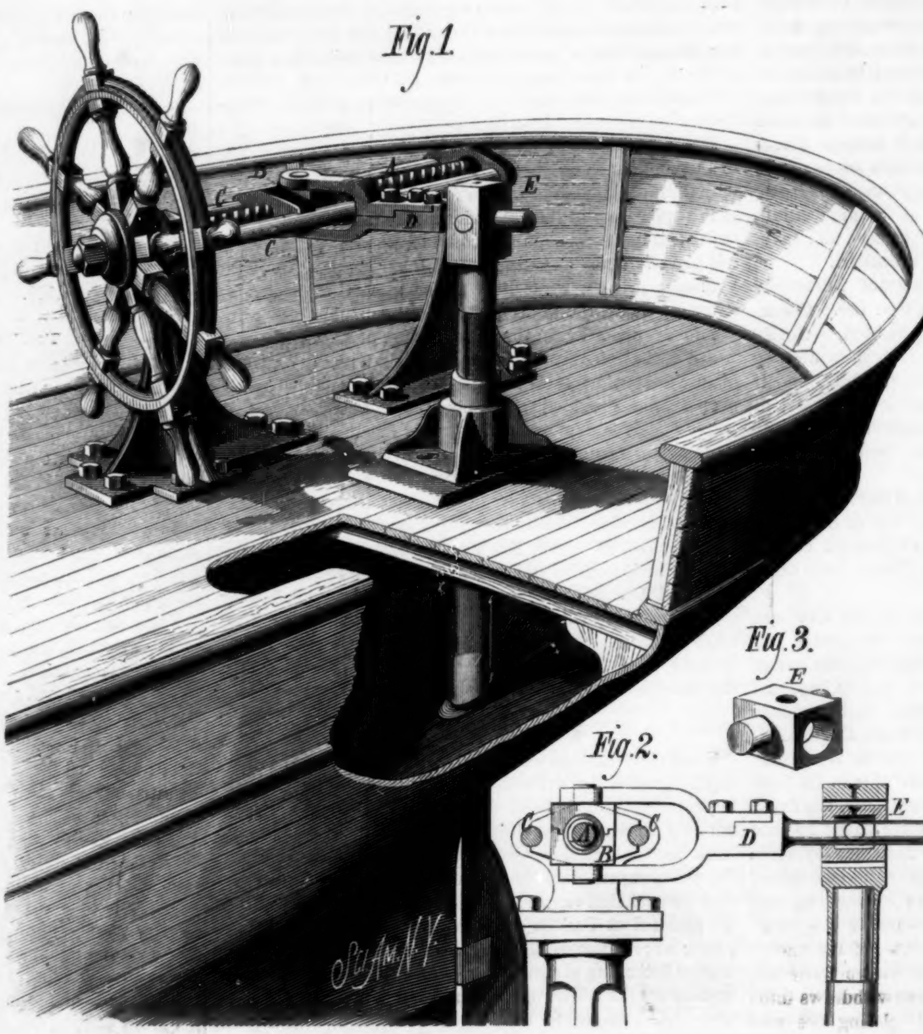
Working as it does at low pressure the new machine is easily kept from leaking without the expensive cocks required in machines working at high pressures. As the liquid has no action on metals, is not explosive, and requires no greasing of the gas pump for lubrication, it is claimed that the more serious difficulties experienced in other processes are practically obviated. There is the further advantage that the liquid is safe to handle and can be transported in ordinary vessels of glass, wood, or sheet iron.

These advantages presented by the binary system are certified by Messrs. C. H. Delamater & Co. as the result of experimental tests made at their establishment.

The ice is formed in large galvanized cans set vertically in a tank containing the non-congealing brine, which is circulated back and forth through the refrigerator of the machine. The cost of fuel and labor in running a 50 ton machine is set down at 78 cents for each ton of ice produced.

The machines are intended for refrigerating breweries, warehouses, dairies, ships' holds, etc., and for cooling hospitals and other buildings, as well as for making ice.

The business development of the invention has been undertaken by the New York Ice Machine Co., whose office is in room 54, Coal and Iron Exchange, 21 Cortlandt street, New York.



SEOANE'S STEERING APPARATUS.

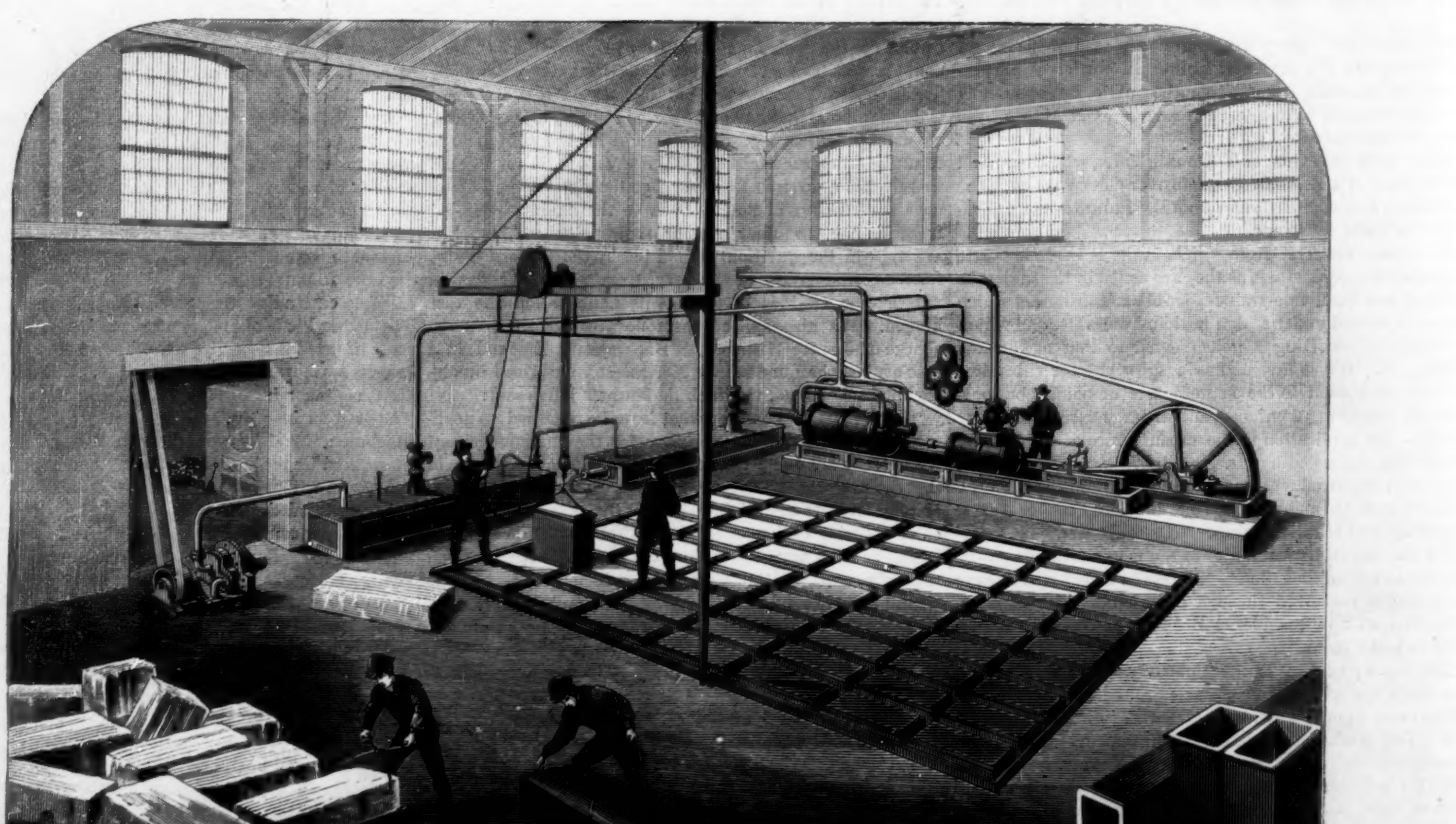
NEW STEERING APPARATUS.

The attention of inventors has been drawn to the need of a reliable steering gear by the alarming frequency of marine disasters attributable to the breakage of steering apparatus, and we are able to present our readers with an engraving of a device that seems capable of fulfilling the requirements, which are really more arbitrary than is generally supposed.

This steering apparatus is the invention of Mr. Pablo Perez Seoane, of Havana, Cuba, Inspecting Engineer of the Spanish Navy. The large perspective view shows the application of the mechanism, while the smaller views represent details not shown in the larger view.

The screw, A, which is provided with a tiller wheel at one end, is journaled in two standards arranged at the side of and equidistant from the rudder post. A traversing nut is placed on the screw, A, and provided with grooved arms capable of sliding on guides, C, arranged parallel to the screw, A, and supported by the posts in which the screw is journaled. The nut is embraced by a box, B, which is split longitudinally and provided with trunnions, which are journaled in the forked end of the lever, D. The upper end of the rudder post is provided with a strong socket, in which is pivoted a box, E, adapted to receive the cylindrical end of the lever, D.

As the tiller wheel is turned in one direction or the other the nut on the screw is moved, carrying with it the forked end of the lever, D, which moves the rudder. As the rudder post turns the lever, D, slides in the box, E, to compensate for the angular motion of the nut. It often happens that the bearings of the rudder post are not perfect, and that every wave that strikes the rudder moves it laterally in its bearings besides tending to turn it. With this arrangement a sudden shock on the rudder post when the rudder is struck by a heavy sea, simply exerts its force in moving the rudder head along the lever, D, and has no tendency to bend or twist any part of the mechanism, nor to put any undue labor on the man at the wheel. It will be seen that any vertical motion of the rudder is provided for in the pivoted connections of the lever, D, with the head of the rudder post and with the traveling nut, so that if the rudder should strike bottom, as in case of running ashore, the steering gear would receive no injury. This device is shown in the engraving as adapted to hand steering, but it may be worked with steam with the same advantages.



THE NEW ABSORPTION PROCESS ICE MACHINE.

MARINE AND LAND HERMIT CRABS.

BY A. W. ROBERTS.

The marine hermit crabs, which the naturalists define as decapods (ten legged) crustacea of the genus *Eupagurus*, ought not be treated with contempt. Their high-sounding name should entitle them to some respect. Their history when told will afford material for observation and reflection.

We will begin with the little hermit crab, Figs. 1 and 2 (*Eupagurus longocarpus*), or long armed hermit crab, common on all parts of our coast, which is considered to be one of the most amusing and intelligent inhabitants that can be kept in the marine aquarium. It is very hardy and will live on either animal or vegetable substances, and is at the same time an excellent scavenger. The favorite dwelling of this crab is an empty shell of the little whelk (*Buccinum undatum*), one of the commonest shells on our coast. When placed in an aquarium these crabs display great activity, and are always on the go, climbing up the rocks and algæ, or scuttling along the bottom with surprising agility.

All the marine hermits have the credit or discredit of being an exceedingly irritable and crabbed family of crustaceans, for whenever two hermits meet they are sure to engage in what appears to be a fierce encounter, until the weaker one abandons the contest and skedaddles in most ludicrous haste, often rolling over and over across the tank. Yet in all these encounters I have witnessed I have never seen as much as a claw lost, and am of the opinion that it is their way of having a good time.

It does not inconvenience a hermit crab in the least to lose or have a claw fractured; all he does or cares is to amputate it down to the next joint, at the same time making a hearty meal of the fragments of flesh that are removed during the operation. In a few weeks a new claw is developed, and he is as well off as ever. All crustaceans have this power of renewing lost members.

The claws, head, and shoulders of the hermit crab are encased in armor as hard as that of the lobster, but the hinder part of the body is soft and defenseless, hence the necessity of protecting it from the attacks of other fish by inserting the caudal extremities into the interior of the empty shells of some sea snail, winkle, or other univalve. By means of the appendages, or hook-like processes at the end of the tail (Fig. 2), the hermit crab is enabled to clasp the upper inside portion of the columella of a shell with wonderful tenacity, and rather than let go his hold will suffer decapitation. Another interesting fact in their organization is that the two sides of the body are unequal in size, thus enabling them to fit compactly in the chamber of the shell, their two larger claws are also unequal, and in some varieties flat on the inner sides, so that when the crab withdraws into his shell they fit closely together, securely closing the entrance against attack from outsiders.

As the hermit increases in size he is reminded by the uncomfortable tightness of his quarters that it is well to be on the look out for a more roomy home. This house hunting and removal is the most trying period in the life of a hermit, and brings out all his wonderful instinct. After carefully examining the empty shells that are in the aquarium he at last selects one for his new home. This he seems to lift up in his claws as if to try its weight, or to be certain there are no holes in it whereby the insidious neris worm might perform a rear movement on him unawares. Being satisfied as to lightness and exterior fitness, he proceeds with great gravity to examine the interior by inserting one of his long claws, very cautiously at first, as if to ascertain if anybody is inside; now twirls the shell round to make sure that it will prove a good fit, and that the walls of the chamber are smooth and free from sand, for the reception of his caudal extremity. Just at this critical moment a big hulking hermit comes along and butts him over, new house and all. For half an hour our house-hunting friend remains motionless inside his shell, with his front door claws closed tight, wondering what it was that went off. Presently out peep his long stalked eyes through a crevice of his claws, just to find out where he is; then he cautiously protrudes his legs and moves off in search of another shell. Coming across the previous one that had so pleased him, he gives it a wide berth, as a dwelling to be avoided by all wise house hunters. Having selected another shell, now comes the greatest trial of all in the life of a hermit crab, which is to get out of the old home and into the new without parting with his soft extremities. For who can tell but that some fish, who has been waiting and watching for many a day for just such a dainty meal of soft crab, is not at this very moment lying in wait for him to catch him just at the moment when he has left the old shell. To defeat such an attempt our little marine friend proceeds to place the entrance of the two shells near together; with most ludicrous haste he whisks out of his old house and backs into his new. For a minute he remains motionless, as if asking the question, "Am I all here?"

Should you wish to have a hermit leave his shell and take up his abode in one of your own selecting, the safest way to accomplish it is to place him on the disk of some large anemone. As soon as the hermit finds himself being engulfed in the thousand tentacles of the anemone he instantly realizes that his only chance for escape is to slide out of his shell and drop down. Another method is to place him in impure water, or water that is deficient in oxygen; but as soon as he leaves his shell he must be placed in good water and supplied with his new shell. The hermit crab is the first creature in an aquarium to show signs of distress when the lower strata of water becomes charged with deleterious gases He will abandon his shell and wander about without it, a most forlorn looking object.

During the months of July and August I have collected large quantities of hermit crabs at Gravesend Bay, Long Island, in the following manner: When the tide has fallen off the sand flats that skirt the Coney Island shore of the bay, I dig a semicircular trench, one foot deep, two feet wide,

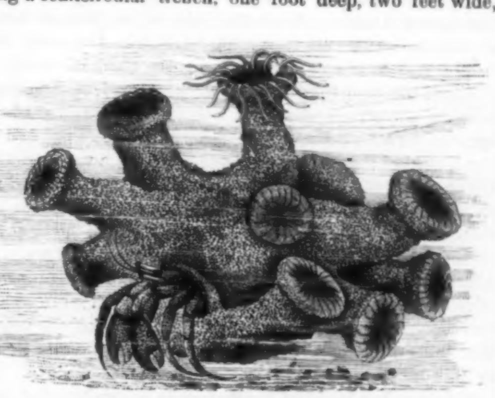


Fig 3.—CORAL HERMIT CRAB.

and about twelve feet long. This trench is situated half way between high and low water. When the tide floods, up come the little hermits with it, to once more be in safety on the flats away from the dogfish and skate, which have a great weakness for these fat little hermits, swallowing them shells and all. When the advancing hundreds of little hermits reach the trench, into it they tumble, nor can they climb up the steep sides of shifting sand.

The next most common hermit crab is the short armed hermit crab (*Eupagurus pollicaris*). This species attains a large size, and inhabits the largest mollusks on our coast, viz., the pyrulas and naticas. I can only recommend this crab for use in public aquaria, it being so strong and active that when placed in a self-supporting aquarium, it soon

Fig. 1.—Little Hermit in Shell.

Fig. 2.—Little Hermit Out of Shell.

breaks up all artistic groupings of rock work and algæ. On different parts of our coast this crab is called by the fishermen "Jack in the Box," "Thief," and "Stone Lobster," and is believed by some fishermen to leave its shell and turn into a lobster. When collecting this crab many specimens will be taken deficient of one eye and even both; this is the work of the black fish and bergalls, which are partial to a diet of crabs' eyes. This fact was clearly proven at the New York Aquarium. When feeding the fish in the "shark tank," small particles of food were left on the floor of the tank, thereby endangering the health of the water. To overcome this difficulty I placed in the tank a large number of short armed hermits and also blue crabs, to act as scavengers; no sooner were they in the water than the black fish began feasting on the eyes of these crabs. Most of the hermits managed to save their eyes by withdrawing into their shells during the day, and only venturing out at night to feed.

Fig 3 is *Eupagurus pubescens*, incrusted with *Epizoanthus Americanus*, one of our native corals. The specimen from which the enlarged drawing was made I dredged at Wood's Hole, Mass., and is about one inch in length by one-half inch in breadth. I generally dredged it in from thirty to forty feet of water.

I have obtained specimens of this crab with only a single polyp cell of the coral attached to their shells, clearly proving the fact that this incrustation of living coral at first starts with a single coral polyp. In course of time this coral growth so nearly closes up the entrance to the shell that the crab inside is unable to make his exit when he wishes to occupy a larger shell, which always occurs when the "shedding" period commences, and in consequence drags out a miserable existence, finally perishing in a tomb of living coral.

This doubly interesting crab lives well in a self-supporting aquarium, but requires to be fed by hand, as it is not much of a forager with the heavy load of coral. In the cut two of the coral polyps are shown fully expanded.

Fig. 4 illustrates one of our most beautiful of land hermit crabs (*Cenobita Diogenes*), native of Florida. For many months past a large number of these interesting and beautifully colored crabs have been on exhibition at the New York Aquarium, and have attracted much attention. This crab does not seem to prefer any particular shell, so long as it obtains a secure covering for its soft and unprotected parts; turbos and cones are all the same to it.

The first lot of these crabs that came under my charge I placed in a tank, from the inner side of which was suspended a chain used for the purpose of pulling out a plug from the bottom of the tank. When feeding them next morning I was surprised to find a number of them missing, nor did I for a long time suspect that they had climbed up the small chain and escaped from the tank. After this discovery I often suspended pieces of twine inside of the tank, up which they would climb at night and treat themselves to a walk around the floor.

These crabs are nocturnal in their habits, and during the day they withdraw into their shells, huddling in one corner of the tank. I fed them on apple, mashed potatoes, and oyster crackers.

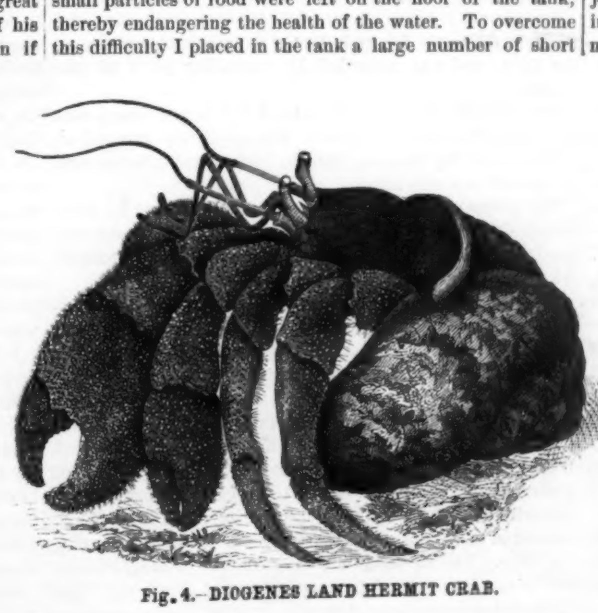


Fig. 4.—DIOGENES LAND HERMIT CRAB.

Fire Engine for H. M. S. Sultan.

On the 13th January, the concluding trial of the steam pumping engine and steam fire engine constructed by Messrs. Shand, Mason & Co., for H. M. S. Sultan, took place on board that ship at Portsmouth Dockyard. The order for the pumping engine was given in consequence of the satisfactory results attending one designed by the same makers for H. M. S. Hercules, which has been in use in that ship since March, 1878. In addition to the pumping engine a powerful steam fire engine, also by Shand, Mason & Co., has been fixed on board the Sultan, both engines being connected with the same boiler. This latter is of the makers' well known "inclined water tube" type, so extensively used with their steam fire engines, the pumping and fire engine being on the plan of their equilibrium engine. The pumping engine consists of three steam cylinders, each 10 inches in diameter, placed vertically and connected direct to three bucket and plunger pumps, the buckets being 17¾ inches with a stroke of 13 inches. The construction of the steam fire engine is similar, but is placed horizontally, the three steam cylinders being 8½ inches in diameter, and the buckets of the plunger pumps 8¾ inches, with a stroke of 8 inches. The boiler and engines are placed sufficiently high in the ship so as to be worked even with a large quantity of water in the hold, special attention having been paid to the valves of the pumping engine, so as to draw water without fail from the lowest part of the ship. The preliminary trial took place on the 6th instant, when the following four jets were used at the same time: one 1¼ inch, one 1 1-16 inch, and two each 1 inch, when a height, as measured by the mast, of 170 feet was reached. It was then found that the means for supplying the pumping engine with a sufficient quantity of water was inadequate, and this test was adjourned for the purpose of making arrangements to admit a sufficient quantity of water into the hold. On the 7th instant a test of the fire engine was made in the presence of Admiral Foley, Superintendent of Portsmouth Dockyard, when with one jet, 1½ inch in diameter, the water was thrown considerably above the top of the mast, a height of 200 feet. The following four jets were used simultaneously, one each 1¼ inch, 1⅛ inch, 1 1-16 inch, and 1 inch, delivering 1,120 gallons per minute under a water pressure of 100 lb. on the square inch. The tests on the 13th instant and that on the 6th were conducted under the superintendence of Mr. Newman, Chief Engineer, Portsmouth Dockyard, Mr. Marcom, his assistant, Mr. Icely, Inspector of Machinery, Captain Wells, Superintendent of the Steam Reserve, Mr. Shearman, Chief Engineer of H. M. S. Sultan, and other gentlemen, all of whom were perfectly satisfied with the result, Mr. Shand being present on behalf of the contractors. The experiments occupied about two hours, the result of half an hour's continuous working with the pumping engine, with an average of 84·6 revolutions per minute, delivering 720 tons per hour from a depth of 21 feet 6 inches below the pump valves, and delivering under a pressure of from 20 lb. to 25 lb. on the square inch, this rate of delivery being practical, not theoretical, as the quantity was tested from the influx of water through valves from the side of the ship into a measured area of the hold.—*Engineering.*

MR GEORGE BERWICK has taken a series of photographs of the moon on very sensitive plates—the bromo-gelatine. One of the plates shows three well defined rings around the moon. Whether the rings are due to cosmical, atmospheric, chemical, or optical causes is not yet determined.

The Manufacture of Porpoise Oil.

BY CAPT. CALEB COOK, OF PROVINCETOWN, MASS.

About the year 1816, sailors and fishermen having caught a porpoise on their voyage, would sometimes extract the oil from the jaw bone and give it to carpenters and those who used oil stones for sharpening their tools. Finding in this way that it did not gum or glue, suggested the idea that it was just what was wanted for a nice lubricator. It was noticed that the weather at zero would not congeal it, neither would it corrode on brass.

Watchmakers were then using olive oil as the only fitting oil for watches; but by experimenting with the porpoise jaw oil they found it superior to the olive or any other oil, consequently the sailors and fishermen found a ready market for all they were able to obtain.

This state of things continued until the year 1829, when a shoal of blackfish, about forty in number, was taken at Provincetown, Mass., being the first for many years. Solomon Cook, of that town, took from the jaws of those blackfish a few gallons of oil, and sent it to Ezra Kelley, of New Bedford, Mass., a skillful watchmaker, to be tested for watch oil. Mr. Kelley soon found that this oil was superior to the porpoise oil, as it had more substance and less chill. He contracted with Solomon Cook to supply him from year to year until 1840, when Solomon Cook died, and his oldest son supplied Mr. Kelley until the demand was so great that the jaws of the blackfish were not sufficient to supply the market.

Porpoise jaw oil can be refined a little by exposure to the cold at zero, and in that state, with the atmosphere at zero, it is strained through a cotton flannel strainer made in the shape of a cone, but when filtered through paper it is so limpid that it has no lubricating properties whatever, and becomes useless. This oil is called porpoise jaw oil, but is taken from the blackfish, belonging in the family of whales, by a method known only by myself. It is warranted not to congeal with cold at zero, though it will thicken and turn a little milky in appearance. It is warranted not to corrode on brass or rust on steel, and it will not glue on the finest watch. Ezra Kelley, of New Bedford, Mass., has made it a business for many years to put it up for watch use, and has led in the market, while B. H. Tisdale, of Newport, R. I., and I. M. Bachelder, of Boston, are getting quite popular in the European market.

Caleb Cook, youngest son of Solomon, from scientific experiments, did discover, about the year 1842, that the melon oil of the blackfish was far superior to the jaw oil in every respect—so much so that Mr. Kelley, who had about this time become very popular in preparing this oil for the trade, would not buy it until he was told what it was produced from; and from that time to the present, 1876, Caleb Cook's blackfish melon (watch) oil has been refined by Kelley, of New Bedford, Bachelder, of Boston, Tisdale, of Newport, and many others on a smaller scale, for the world's use. Since the year 1842, Caleb Cook, of Provincetown, Mass., claims to be the only person who understands the art of producing this oil free from all glutinous matter and fit for use. This, he says, is done by a process known only by himself—not by mixing other oils or liquids with it, but by extracting all the acid and gluten from it, and leaving the oil pure for the finest and most delicate machinery. This, he says, cannot be done by the chilling and straining process; for when it becomes perfectly transparent at zero, the lubricating properties are all gone, the oil runs off the pivots, spreads on the plates, dries up, the pivots cut, turn red, and the oil is worse than worthless, for the valuable timekeeper is no longer what it was once for the want of oil with more substance and lubricating properties.

Porpoise jaw oil and blackfish melon oil are worth from $5 to $15 per gallon, according to supply. These oils are sold under the above trade names, and also under the names "watch oil" and "clock oil." They are used largely by manufacturers of firearms, watches, and philosophical apparatus. Smith & Wesson, of Springfield, Mass., the Ethan Allen factory, at Worcester, Bye & Johnson, of Worcester, the Howard Watch Company, the Elgin Watch Company, the Waltham Watch Company, and the clock factories in Connecticut, use them constantly. The philosophical instrument makers use them for air pumps, as they keep the leather always soft and pliable. Telegraph instrument makers use them when they can get them. They are used in government lighthouses for the clocks of revolving lights. The color of the oils is very light, and can be made very white by placing in the window, where they will bleach in a short time. One drop of water in one pint of the oil will injure it very much.

It may be interesting to know how those fish or whales are taken. They make their appearance about the shores of Cape Cod and Barnstable Bay from early in the summer until early in winter; and when it becomes known that a shoal of blackfish is in the bay, the boats are manned and proceed at once to get in their rear; and, as the fish are at the surface of the water the most of the time, it is easy to tell how to manage to keep them between the boats and the shore. While in this position the men in the boats will make all the noise with their oars they can, and that will cause them to go in the opposite direction from the boats and toward the shore; and when the fish find that they are in shoal water, by seeing the sandy bottom, they become alarmed, and go with all their might till they run fast aground on the sand. The boats then row in their midst; the men with lance in hand jump out of their boats into the water, and butcher them as a butcher would a hog, and it becomes one of the most exciting occasions that it is possible to imagine, for the water flies in every direction, and the blood flows freely until death puts an end to the great tragedy. When the water ebbs and leaves them dry, their blubber is taken off, cut in slices, and the oil tried out. About thirty gallons upon an average is what one fish will make, and the melons will average about six quarts. The melons are taken from the top of the head, reaching from the spout hole to the end of the nose, and from the top of the head down to the upper jaw. When taken off in one piece, they represent a half watermelon, weighing about twenty-five pounds. When the knife is put into the center of this melon, the oil runs more freely than the water does from a very nice watermelon—hence the name melon oil.

About the same time that the blackfish made their appearance in our waters, another of the whale species made its appearance also, called by the fishermen "cowfish" and by the historian "grampus." These whales are very much in the shape of the blackfish, only smaller, not so fat, and not so dark colored. The oil from the melon of this fish is thought to be superior to anything yet found in the blackfish or the porpoise. It is of a very yellow color, and when reduced by the chilling and straining process, it appears to have all the body and lubricating properties that are wanted for the very best watch oil; but as it will take one year to determine it by practical experiments, it is thought best to keep it out of the market for the present.

This fish has made its appearance in our waters but three or four times in the last forty years, or about once in ten years. The method of taking it is the same as for the blackfish.

Cape of Good Hope Whales.

The villages between Simon's Bay and Wynberg have fences made of various bones of whales. A whale fishery was formerly carried on here, but no longer pays. An extremely interesting and very rare whale is occasionally procured at the Cape. It is a ziphioid, *Mesoplodon layardii*. The ziphioids are a group of the toothed whales, and allied to the sperm whale. They have the bones of the face and upper jaw drawn out and compressed into a long beak-like snout, which is composed of solid bone, hard and compact like ivory.

The upper jaw is devoid of teeth, having lost them in the process of evolution, and the lower jaw, which is lengthened and pointed to correspond with the upper, retains but a single pair of teeth. In the species in question, these two teeth in the adult animal become lengthened by continuous growth of the fangs into long curved tusks. These arch over the upper jaw or beak, and crossing one another above it at their tips, form a ring around it and lock the lower jaw, so that the animal can only open its mouth for a very small distance indeed.

The tusks are seen always to be worn away in front by the grating of the confined upper jaw against them. How the animal manages to feed itself under these conditions is a mystery. It is remarkable that the main mass of each tusk is made up of what appears as an abnormal growth of the fang. The actual conical tooth, that is, the orginal small cap of dentine of the tooth of the young animal, which corresponds to the part of the tooth showing above the gum in other whales, does not increase at all in size, but is carried up by the growth of the fangs, and remains at the tips of the tusks as a sort of wart-like rudimentary excrescence.

Specimens of *Mesoplodon layardii* are excessively rare, and I sought diligently for such during the whole of my stay at the Cape, and was rewarded by procuring parts of two skulls.

One of these, a skull without the lower jaw, I found near Mr. McKellar's at Cape Point. The skull was exposed on the beach, being stuck up with its beak thrust into the sand to be used as a rifle target.

The animal, as Mr. McKellar told me, had come on shore about eight years before. It yielded oil of a very superior quality, which sold for more than twice the price of ordinary whale oil.

It was about 10 feet in length, and was, as far as he remembered, colored black on the back and white on the belly, with a conspicuous line of demarkation of the colors on the side. The beast had the usual tusks.

The other specimen consisted of the snout and lower jaw, with the tusks, of another example of the species. It was given me by Mr. A. M. Black, of Simon's Town. The animal came on shore at Walwick Bay in 1869. It yielded 80 gallons of oil, and was from 16 to 18 feet in length. It is remarkable that these whales seem never to be met with or caught at sea. They always are procured by their running on shore. The ziphioids are especially interesting, because many species were abundant in tertiary times, and their beaks being so dense in structure as to be readily preserved as fossils, are common in such deposits as the Red Crag of Suffolk. I had the good luck to procure another ziphioid at the Falkland Islands during the voyage, near Port Darwin.—*H. N. Moseley's Challenger Notes.*

In the Clutch of an Octopus.

Our readers are familiar with the appearance of the octopus from the illustrations of it which have appeared in these columns, and therefore they will understand the manner in which a diver in Australia was attacked by one of these monsters, as graphically described by the victim in the Melbourne *Argus:* "Having thrust my arm into a hole, I found that it was held by something; the action of the water was stirring up the clay, and therefore I could not see distinctly for a few minutes; but when it did clear away I saw to my horror the arm of a large octopus entwined around mine like a boa-constrictor. Just then he fixed some of his suckers on the back of my hand, and the pain was intense. I felt as if my hand was being pulled to pieces, and the more I tried to take it away the greater the pain became; and from past experience I knew this method would be useless. I had the greatest difficulty in keeping my feet down, as the air rushed along the interior of my dress and inflated it; and if my feet had got uppermost I should soon have become insensible; and if I had given the signal to be pulled up the brute would have held on, and the chances would have been that I should have had a broken arm. I had a hammer by me, but could not reach down to get it. There was a small iron bar about five feet from me, and with my foot I dragged this along until I could reach it with my left hand. And now the fight commenced; the more I struck him the tighter he squeezed, until my arm got quite benumbed. After a while I found the grip began to relax a little, but he held on until I had almost cut him to pieces, when he relaxed his hold from the rock and I pulled him up. I was completely exhausted, having been in that position for over twenty minutes. I brought the animal up, or rather a part of it. We laid him out, and he measured over eight feet across; and I am convinced that this fellow could have held down five or six men."

Women as Physicians.

In an article in the *International Review*, Dr. Chadwick makes the just observation that the question is no longer, Shall women be allowed to *practice* medicine? They are practicing it, not by ones and twos, but by hundreds; and the only problem now is, Shall we give them opportunities for studying medicine before they avail themselves of the already acquired right of practicing it? It is clearly the interest of the community to give to women the fullest instruction, in accordance with the most improved systems, and under the most eminent teachers; and also that their proficiency should be tested by the most rigid ordeals before they finally receive certificates. By a recognition of these certificates and their comparative values, the community would be able to protect itself from the impositions of ignorant or fraudulent pretenders to medical knowledge.

In this connection it will be interesting to notice the remarkable medical missionary work now going on in China, and the skill of an American young lady physician, Miss L. A. Howard, who has lately had the good fortune of restoring to health the wife of the great Governor-general Li-hung-chang, who entertained General Grant so handsomely. Rev. D. Z. Sheffield, of Tung-cho, North China, writes as follows to the *Missionary Herald:*

"Recent letters from missionaries in North China give intensely interesting accounts of the sudden providential inauguration of medical missionary work in Tientsin, on a grand scale, and under very remarkable auspices. The importance of this advance movement can hardly be overestimated, and it is not too much to be hoped that it will give a new impetus to every department of missionary effort."

Rev. A. H. Smith, of Tientsin, writes as follows: "Dr. Mackenzie, a medical missionary of the London Mission, was transferred to this city last spring, with a view to opening an extensive medical work here, which has never yet been done. A petition was presented to His Excellency the Governor-general of the province, Li-hung-chang, the most influential man in China, asking his co-operation. Owing, perhaps, to the arrival of General Grant and the ensuing excitement no reply was made. A few weeks since the wife of His Excellency, long an invalid, was so low that native physicians gave her up after administering all the most expensive drugs in the Chinese pharmacopœia, and, as they told the Governor-general, knew nothing else to do unless to begin and give them all over again! In this emergency two foreign physicians were summoned, who saved Madame Li's life. As Chinese prejudice forbids much that occidental civilization allows, it was necessary to a complete cure to summon a lady physician, which was done with the assent of His Excellency the Governor-general.

"Miss L. A. Howard, of the American Methodist Mission, arrived here early in August, and took up her quarters in a suite of three rooms near to Lady Li in the yamên, or official residence. Missionaries have occasionally been in the yamên of viceroys before, but it has generally been either in the capacity of beggars or as prisoners, never as physicians in charge. Miss Dr. Howard has lived in the yamên about three weeks, and Madame Li is so far recovered as to be considered well. The fame of foreign medicine has gone abroad with the highest indorsement. The foreign physicians operated in certain surgical cases in the yamên, and the patients made a successful recovery. As native doctors know nothing of surgery this is looked upon as a wonderful art. The Governor-general has not formally granted the petition referred to, but he has opened a dispensary in the largest temple in Tientsin, in that portion of it used as a memorial temple to his predecessor, the late Tsêng-kuo-fan. The medicines are furnished by the Governor general, and the missionary physician in charge has full liberty to preach the gospel to every patient. A few weeks ago such an event would have been considered utterly improbable. Its consequences can hardly be foreseen. Li-hung-chang is the statesman who last year remarked, during the famine relief, that there must be something in a religion which induces men to lay down their lives for total strangers of a

different nation. Little by little the great wall of Chinese prejudice is falling in pieces. As it falls Christianity enters."

Rev. Isaac Pierson, of the Pao-ting-fu station, who spent some weeks at Tientsin, writes at a later date: "A commission was sent (by Li-hung-chang) to Dr. Mackenzie, appointing him, in company with Dr. Irwin, physician to the yamên—the latter practicing medicine for a calling, being made the recipient of a salary which will equal five hundred dollars a year. Dr. Mackenzie was appointed, or commissioned, 'to heal the sick,' of the city, and a large yard with ample buildings was forthwith set apart to his use. This is part of the great temple of the city recently built by the same Viceroy—the temple in which he received and did honor to General Grant. Miss Howard has been promised a similar commission to treat the women, and is to have another court and buildings at the temple for her dispensary. The Viceroy promises to pay all the expenses of this dispensary work.

"For nearly three weeks the dispensary has been opened, and Dr. Mackenzie, assisted by our vice consul, Mr. Pethick, who has been indefatigable in his labor of love, has daily given treatment to eighty or ninety patients, in addition to an average of forty or fifty opium takers, who with medical help are trying to break off the habit of using opium. Many interesting surgical operations are performed. Four days ago the number of hare lips cured had reached eleven. There is a general of the army at the dispensary whose leg is being reset for an old fracture. Many other surgical operations have been successfully performed. In all this the Viceroy is intensely interested."

This feature of surgical operations, performed with the approval of the Viceroy, strikes one acquainted with the former prejudice of the Chinese against the use of the knife on the human body, as the most remarkable thing in this whole movement. In past years foreign physicians have not dared to let it be known that they had such a thing as a human skeleton in their house, and a few years ago, when Dr. Dudgeon was lecturing to the students in the Peking University on the anatomy of the human body, he dissected a sheep in their presence, as the dissection of a human body would not for a moment have been allowed. Mr. Pierson further says: "It has been said by some that a medical work could not be carried on here, but here is one already started, upon a basis superior in many respects to any in China, and with the strong presumption of its being a permanent one."

From these letters it will be seen how rare is the opportunity for medical missionary labor in North China. Preaching missionaries are already offering themselves to go and strengthen the hands of their brethren in that interesting field. No grander opportunity could be offered to the consecrated ambition of a Christian physician than that now offered. Urgent appeals are being made for physicians from the stations of Pao-ting-fu, Kalgan, and Tung-cho. Shall not the hearts of the brethren at the front be soon cheered with the glad intelligence that men are on the way to enter upon the work of ministering to men's bodies, and thus assist in the great work of ministering the bread of life to the famishing myriads of the heathen?

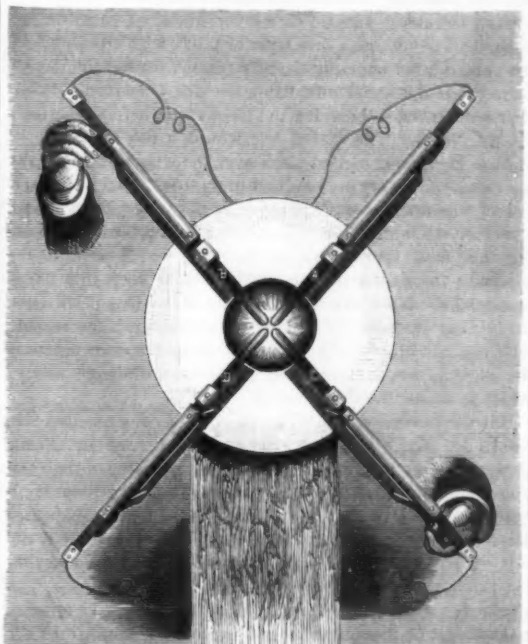
THE STEAM VELOCIPEDE.

At the recent Industrial Exhibition at the Champs Elysées, Paris, M. Perreaux, of Orne, exhibited a steam velocipede, which is illustrated herewith. The generator, the fireplace, and the motor are arranged behind the saddle of the velocipede, after the manner of the portmanteau of a horseman. Chains or belts transmit motion from the engine to the wheels. All the parts are small, well put together, and very compact. The small tubular boiler is cylindrical and has a capacity of about three quarts; and at the sides there are two receptacles containing a sufficient supply of water to last during a journey of two to three hours. The piston of the engine is about one inch in diameter and has a three inch stroke. The whole engine is a mere plaything, and yet, with a pressure of three and a half atmospheres, it has sufficient power to drive the velocipede at a speed of from fifteen to eighteen miles per hour. The fireplace which heats the boiler is an ingenious novelty, and consists of a small gasometer fed by wood spirit. The vapor of the alcohol issues through holes, and gives a flame endowed with great calorific power. The fire is lighted at will, and in a few minutes steam is up. A method is provided for regulating the escape of the alcohol vapor, and consequently the intensity of the heat. Externally the boiler is furnished with two tubes rolled in the form of a spiral, so that the steam which is produced circulates through these continuously, and is exposed directly to the fire before entering the motor. The steam being superheated, no water is carried over with it. With a speed of eighteen miles an hour, the cost of alcohol consumed is from forty to sixty cents (this calculation, of course, for France). This is certainly not very economical, but it is very pleasant to have a horse under control which eats only when he works.

STEAM VELOCIPEDE.

THE ELECTRIC SUN.

At the recent Industrial Exhibition at the Champs Elysées Paris, M. Lontin exhibited an apparatus with which a very interesting experiment may be tried. This device, which the inventor calls the "electric sun," is composed of four carbons radiating from the same center, but not touching each other. Four currents are passed through these carbons in the following manner: The first current enters at A and issues out through the carbon B. The second leaves through this same carbon and enters through the carbon C. The third current enters through the carbon C, and leaves through the carbon D. The fourth enters through A, and



THE ELECTRIC SUN.

leaves through the carbon D, the result being a complete circle of light, which is due to the formation of four lateral voltaic arcs. The light obtained is exceedingly intense. This experiment proves that by this means foci of light of indefinite power may be obtained. When the carbons are further separated from each other flames are produced, not as they are under ordinary circumstances—with a diminution of light—but, on the contrary, with a considerable increase of it; and these flames sometimes attain a length of six inches, and quite often assume a forked shape. From whence comes this anomaly of a flame, augmenting the luminous intensity of the voltaic arc, and that too so strongly?

MISCELLANEOUS INVENTIONS

Mr. Harry L. St. Clair, of Winneconne, Wis., has patented an improved ironing table having pairs of legs which are hinged and jointed together in such manner as to adapt them to fold closely against the top.

Edwin T. Greenfield, of New York city, has patented an improvement in automatic electric switches for telephones. The object of this invention is to provide for an automatic switch a movable electric or magnetic conductor that by its own gravity shall make or break magnetic and electric connection.

An improved attachment for vehicle wheels, to strengthen the felly joints, and at the same time keep the tires in place upon the wheels, has been patented by Mr. Charles Cremer, of Cosumne, Cal. It consists in the combination of a cap plate, formed to fit upon the rounded inner edge and the sides of the ends of the fellies, provided with pins to enter holes in the inner edges of the felly ends, and having its side arms projecting to overlap the side edges of the tire, and perforated with countersunk holes to receive a rivet.

Mr. Carl J. Swanson, of Stockwell, Ind., has patented a pump that can be used as a force pump or as an ordinary suction pump. The invention consists in a stopper composed of an inner ring of elastic material, an outer wooden ring, and two flat metallic rings.

Mr. George Binns, Jr., of Brooklyn (E. D.), N. Y., has patented a process and mechanism for forming pipes or tubes of pulp, for use as non-conducting coverings for steam pipes, generators, hot air pipes, water pipes, and gas pipes, and for use as conductor pipes for gas, steam, sewage, water, and other liquids.

Mr. Emil R. Völkel, of New York city, has patented a new method of taping furs which is simple and effective, and produces a strong and durable fur. It consists in fastening the strips of fur to some suitable backing by means of adhesive materials.

An improvement in slop jars has been patented by Mr Maurice Stransky, of New York city. The object of this invention is to furnish slop jars so constructed as to prevent spattering when liquids are poured into them, and to prevent odors from escaping into the room.

Mr. Emanuel J. Trum, of Brooklyn, N. Y., has patented an improved blotter which consists of a pad made of alternate sheets or layers of bibulous and non-bibulous paper, glued together at their ends in a manner to facilitate their ready separation.

An improvement in velocipede sleds has been patented by Mr. James H. Dennis, of Newark, N. J. The invention consists of a saddle, an open wheel standard carrying an end pivoted screw, a lever fulcrumed and connecting at one end with the screw and pivoted at the other end to a rod hooking on a crank shaft carrying spike wheels.

An improved game bat, patented by Mr. James O'Neil, of New York city, is composed of thin strips of wood bent double upon a form, and secured one upon the other by cement. The strips are spread at the bend to the required shape for the bat and united at their ends to form the handle. Between the layers of the strips forming the bow a strip of vulcanized or other fiber is interposed for imparting greater strength and elasticity.

An improvement in saddle-girth rings, patented by Messrs. Arnold Jehnke and John Swank, of Denver, Col., consists in constructing girth-rings with teeth or shoulders to prevent the strands of the rope or girth from being crowded together, and also in providing the girth-rings with pairs of stop rings to allow the middle part of the girth-rings to be left free from strands if desired.

Meteors.

News comes from Missouri that a man has been killed there by the downfall of a meteoric mass. It is described as about as large as a bucket, and resembling iron pyrites. It cut its way through the branches of a maple tree as clean as a cannon ball could have done, struck and killed the man, and then buried itself two feet in the ground. At first, many supposed the account to be a cleverly invented story of the great gooseberry type, but it has been confirmed, according to Mr. R. A. Proctor, in the Newcastle (England) *Weekly Chronicle*. The chance of a death occurring in any given year by meteoric downfall is small, but not so exceedingly small as many imagine. It could readily be calculated if we knew the average number of meteorites, large enough to break their way through the protecting armor of the air, which fall each year upon the earth. We may fairly assume that each human being (including all ages) presents an average surface toward the meteoric missiles of about one quarter of a square yard. (We must, of course, take into account the circumstance that meteors do not fall vertically; nor are all men all the time afoot.) Assuming the number of human beings in the world at each instant to be about 3,000,000,000, the space thus occupied by the human race as a whole would be one quarter of 3,000,000,000 of square yards. (It will presently be seen why I leave the result in this form.) Now the earth's surface contains 200,000,000 of square miles, each containing (nearly enough for such a calculation as this) 3,000,000 of square yards. Hence the surface of the earth contains 200,000 times 3,000,000,000 of square yards, whereas the human race covers but one quarter of 3,000,000,000 of square yards. So that the human race occupies but 1 800th part of the earth's surface. Therefore, if 2,000 meteorites annually reach the surface of the earth, the chances are but as 1 in 400 that one of these will kill a human being. On the average one human being would be killed in 400 years. It is worthy of notice, however, that if Professor Newton, of Yale College, is right in asserting that 400,000,000 of meteors of all orders, down to those visible only in a telescope, fall each year, the

chances of death from meteoric downfall would be very great were it not for the very efficient protection afforded by our air. For in that case, as 400,000,000 exceeds 800,000 500 times, we might expect that on the average 500 persons would be killed each year. For the smallest meteor, traveling with planetary velocity, or many times faster than a cannon ball, would unquestionably be able to deal a fatal stroke. Fortunately there is no risk from these smaller meteors, for they are all vaporized in their rush through the air.

Wooden Pavements.

During a recent discussion of the American Society of Civil Engineers in this city of a paper by Mr. E. P. North, on "The Construction and Maintenance of Roads," Mr. Edward R. Andrews made the following interesting remarks:

Mr. North states that a well made macadam road constructed with trap rock is, after an earth road, the pleasantest and safest known. But trap rock or other really good materials for making macadam roads are not available everywhere, and at best macadam roads are only adapted for pleasure travel in parks or suburban towns, where they can be constantly watered and never allowed to get out of repair. Macadam is not adapted for general use in cities. Under heavy traffic, the surface is constantly ground into powder, which rises in dust in the summer, and they are very muddy in the winter. Even in Paris, where the maintenance is most thorough, the streets being continually watered in summer in the manner described by Mr. North, and frequently washed after a day of unusual wear, and scraped by a large army of cantonniers, yet, after heavy rains, the mud is frequently nearly ankle deep, and in very hot weather during the intervals of watering, or in frosty weather, the air is filled with most penetrating dust. Mr. Flad describes the same state of things in St. Louis; and, in Boston, when, in winter, there is no snow to cover the ground, and on account of the cold, the streets cannot be watered, the dust is intolerable; and in summer, where, for economy's sake, watering is neglected, a large part of the material with which the roads are made is blown into the sea.

The compressed asphalt, so common in London and Paris, when constructed as thoroughly as it is in those cities, and as that on Fifth avenue in front of the Hotel Brunswick has been, is a most excellent pavement, but it also demands the most careful maintenance. No dirt should be allowed to accumulate upon it. In frosty or in damp weather, coarse sand or fine gravel should be spread over the surface to give a good footing for horses. This is done abroad, and then it is not slippery; it is very quiet, and in fact has almost all the qualities needed in a perfect pavement, but it can only be laid on levels, and is expensive.

Stone block pavements are in many parts of the country the cheapest, and possibly may be the best where the traffic is very heavy, but it is emphatically the worst pavement for streets of residences or wherever quiet is desirable; and there is no question but that if the incessant din from the rattling of omnibuses, heavy teams, milk wagons, etc., from which one suffers in large cities paved with stone blocks, could be dispensed with by adopting a quiet pavement, the length of life of citizens would be increased and the general health improved. Such would have been the case long ago in New York had it not been that the wooden pavements laid during the "Tweed" days were such evident jobs. In London, wooden pavements give entire satisfaction. The earliest were not quite successful, but the defects in construction have been remedied, and now broad areas of heavily worked streets previously paved with stone are being laid with wooden blocks, which are found to wear satisfactorily.

In the West, where stone for pavements cannot be had, wooden blocks are largely used; but, as wood is cheap and can be replaced without much expense, no sound principles are followed in their construction. In the Eastern States, no one will allow that a wooden pavement can be good except when newly laid, when all agree that it is delightful. There seems to be an unwillingness, even among engineers, to give the subject the attention it deserves. All agree that stone pavements are a curse, and that it would be a blessing if a good substitute could be found, but because wooden pavements, as they have been made here, have not been a success, condemn them as a class.

Mr. North has stated what has been the general practice in laying wooden pavements in this country. Many methods have been tried, but they have almost without exception been "laid with *green* or wet blocks, more or less thoroughly dipped in tar, on a bed of sand, not always well rammed, with or without the interposition of a tarred pine board, with transverse joints from one to one and a half inches wide filled with gravel and coal tar," and I might add, the whole done in a most unworkmanlike manner.

The results are what might have been expected. The careless manner in which the joints have been filled, has left many channels open for the admission of water, which undermines the sand foundation, so that there is an uneven subsidence under the passing wheels, and holes, small at first, but daily growing larger, appear, so that the surface is soon destroyed. The result is but little better when tarred boards are laid under the blocks. This practice of tarring wet, sappy boards and blocks seems to be an invention to make them decay as soon as possible. It closes up the cells of the wood, so that the moisture cannot escape: fermentation immediately follows, which quickly destroys the strength of the fibers and reduces them to punk. A pavement, constructed in this manner, would fail of course. Thoroughly seasoned wood might be benefited by the tarring process, but green wood never.

Observe how differently wooden pavements are constructed in London. Mr. North describes several methods, either of which is vastly superior to any of the patented systems used here. A rigid foundation of bituminous or cement concrete is universal. This costs more than sand, but it is permanent, and will prevent the blocks from sinking under the wheels. English engineers, in discussing pavements, call the foundation the true pavement, the blocks being the wearing surface only. The "Henson" pavement, with some modifications, strongly recommends itself to my mind as the best for this country. Instead of a layer of tarred paper on the concrete, I would use a thin layer of pitch, with oil enough in it to make it permanently slightly plastic, setting the blocks upon it while hot and soft, using the strips of tarred felt between the rows, and driving the blocks together as described by Mr. North. The tarred felt would make a very close joint. Then pour melted pitch over the whole surface, taking care to fill every crevice, and upon this spread fine sharp gravel, which will work into the ends of the blocks and form a surface resembling macadam, and afford a far better footing than wide spaces between the rows, which serve as receptacles for mud and dust. It is easy to keep this pavement clean. No water can penetrate it, so that it will not be injured by frost. The blocks themselves, if creosoted, will not absorb water, and if laid without spaces between the blocks, the drainage will be surface drainage solely, which is of the first importance.

But the pavement would be short-lived if *green* and wet blocks are used. It is not practicable to use, as Mr. North says is the case in London, "wood better seasoned than the pine generally used by house carpenters in this country." Seasoned wood cannot be obtained in sufficient quantities here. But, what is far better, it can be preserved from decay. I have no faith in any method of wood preservation for paving blocks which does not exclude water. The blocks are so short that any soluble preparation is quickly washed out of them, and, if not made waterproof, they are certain to absorb the seeds of destruction from the filth in the streets. The blocks should be well saturated with creosote oil, whose chemical constituents act preservatively upon the fibers of the wood by coagulating the albumen of the sap, while the fatty matters act mechanically in obstructing the pores of the wood and keep the water out. At the same time, as oil cannot be injected into wood full of moisture, the thorough artificial seasoning, which forms a part of the process of creosoting as carried on in this country, is as useful to the timber as any of the metallic salt processes.

By thoroughly creosoting the blocks, expansion and consequent throwing out of the blocks is prevented. They will not shrink or expand. The wood is also rendered homogeneous; the sap wood becoming as durable as heart wood. Looking to sanitary considerations, the creosoted wooden pavement is perfect. The carbolic acid contained in the oil is a powerful disinfectant, and as the pavement described will not absorb any deleterious substance from the surface, it has only to be kept clean to maintain the best sanitary condition. This is far from being the case with wooden pavements laid on the American plan. They soon become a mass of decaying vegetable matter, and, as their powers of absorption increase with their disintegration, they become filled with corruptible matter absorbed from the filth of the street, and as their surface becomes filled with holes, it is absolutely impossible to keep them properly clean.

A good wooden pavement is also an inexpensive one. The cost, including a cement concrete foundation, 6 inches deep, would not exceed $3 per square yard. The system of maintenance adopted in London, of making it a part of the contract of construction, would insure good workmanship in laying the pavement, and a good permanent roadway afterward. It would not be difficult to find responsible and honest contractors willing to take such a contract at a fair price.

In considering this subject, one should not overlook the statistics of accidents gathered in London by Col. Haywood, which show that a London horse will travel on granite 132 miles, on asphalt, 191 miles, and on wood, 446 miles, before an accident occurs.

The actual wear of wooden blocks is very slight, as long as the fibers of the wood are sound. Mr. North states that it is one eighth of an inch per annum in the streets in London, with the heaviest traffic. Mr. Geo. Frederick Deacon, Member Inst. C. E., in a paper read before the Inst. of C. E., states that in Great Howard street, Liverpool, which is a shop street, with a traffic consisting chiefly of carriages, amounting to about 94,000 tons per annum per yard in width, the pavement was worn to the extent of ⅝ of an inch in four years. This would give a life of nearly twenty years before the blocks would be reduced from 6 inches to a thickness of 3 inches, which is still sufficient to maintain the blocks in place.

In Oxford street, in London, where the traffic is equal to 300 tons per foot per day, the amount of wear has been found to be from 1-16 to ⅛ inch during three and a half years. This street is laid with the Henson pavement. This slight wear is largely due to the fact that the ends of the fibers do not broom, and thus retain their original strength.

The cost of creosoting is $12 to $16 per thousand feet, board measure.

Spruce does not absorb oil readily on account of the compact character of its fibers, yet it will take in a gallon of oil per cubic foot; hemlock, pine, both white and yellow, and porous oak, are more absorbent. Wood which is the most destructible, because it absorbs water readily, is really the best for creosoting, as, for instance, the gums and cottonwood.

The amount of carbolic acid in the oil I have not taken any pains to ascertain. The quantity depends upon the character of the coal from which the gas was made, varying from 5 to 10 per cent. It has been ascertained, however, through careful experiments by a Belgian chemist, that the wood preserving qualities of creosote oil are due rather to the waterproofing imparted to the wood by the hydrocarbons contained in it than by the carbolic acid. The latter is very volatile, and were it not retained by the gummy, resinous oil would quickly escape into the air. In England no reference is made to the quantity of carbolic acid contained in dead oil to be used in the specifications for contract work. Carefully conducted experiments of my own with pieces of yellow pine, 8 inches by 8 inches and 9 feet long, have shown that six months after treatment they did not absorb any water during a soaking of 48 hours under water.

ENGINEERING INVENTIONS.

An improvement in moulds for sewer building has been patented by Mr. James Burns, of San Antonio, Texas. This improvement relates to moulds or centerings for use in building sewers of concrete, artificial stone, or brick; and it consists in a collapsible mould, made of convenient length, and of the cross sectional shape required for the sewer, and fitted on wheels, so that the sewer can be built in sections around the mould and the mould moved along the trench from time to time as the sections are completed.

An improved railroad switch, patented by Mr. Conzac S. Bastright, of Lebanon, N. H., is so constructed that the wheels of a train of cars advancing from either direction will bring the switch rails into line with the rails of the main track should they be in line with the side track, so that a train cannot run from the main track to the side track unless the switch rails be purposely arranged to produce that result.

Mr. Robert Schneckenburger, of Jackson, Mich., has patented an improved self-adjusting packing designed for rotary engines, rotary pumps, blowers, air compressors, etc. The invention consists in a rotary engine one of whose cylinder heads has a steam passage and apertures connected by a groove in combination with a packing strip.

Mr. Peter Barclay, of East Boston, Mass., has patented an improvement in lubricators for steam engines, wherein the oil is caused to flow in regulated quantities by means of steam pressure. The invention consists in a cup having a perforated diaphragm near the bottom, by which a general pressure on the oil may be obtained without any condensing tube in the cup.

Messrs. Franklin O. Wyatt and Edwin Smedley, of Dubuque, Iowa, have patented an improvement in iron trucks for locomotive tenders and railroad cars, the object being to construct a strong and durable truck, capable of withstanding severe shocks without tearing asunder, and which, after being bent, may be restored to shape.

Gold and Silver in Maine.

Important mining discoveries have been made in Maine during the last few months. Companies have been organized, and work is being energetically prosecuted in various parts of the State. The deposits are principally of gold and silver. The Acton lode, in York county, is reported by Professor Stewart to be one of the best defined fissure veins on the continent. It has been traced for two miles from north to south in nearly a right line, and the surface exposures show that it ranges in lateral diameter from eight to twenty feet. The Riverside Mining Company has been organized at Camden, in Knox county, with a capital of $500,000. Work was begun about six weeks ago, and is being pushed night and day. The shaft of the Fort Knox mine, at Prospect, opposite Bucksport, on the Penobscot River, is now down sixty-two feet, and the ore from the bottom contains both gold and silver. A fine specimen of very rich ore from the Deer Isle mine, on Deer Island, Penobscot Bay, has just been exhibited in Bangor. An assay resulted as follows: Gold, $30; silver, $60; copper, $10; lead, $17. The Owl's Head mine, seven miles below Rockland, at the mouth of Penobscot Bay, is showing specimens of quartz very rich in gold. The Hampden Mining Company has a shaft eight miles westward from Bangor, which is down sixty-five feet, and blasts throw out ore of good quality. The Atlantic mine, at Blue Hill, is equipped with steam engine and drills, and the shaft is already sunk over fifty feet. The assayer of the Blue Hill Mining and Smelting Company writes, under date of the 11th January, that things are progressing at a lively rate. Five or six other mines report favorably, and important additions to their outfits will be made in the spring with a probable enlargement of operations.

MAGNESIUM STEEL.—A half per cent of magnesium changes coarse-grained into fine grained steel and greatly improves the quality. The magnesium is introduced through an opening in the cover of the crucible, after inserting some small bits of charcoal, in order to remove the free oxygen. Without this precaution there would be danger of an explosion.—*Ber. der Chem. Gesell.*

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ *The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.*

NEW BOOKS AND PUBLICATIONS.

MILLS' DIRECTORY OF STEAM BOILER AND ENGINE OWNERS, ENGINEERS AND STEAM USERS IN NEW YORK AND BROOKLYN. New York: Jas. N. Mills. Price $3.

Business men having dealings with engineers and steam users will readily appreciate the value of 6,000 names and addresses in lines in New York and Brooklyn. The book is neatly made.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) E. F., J. S. B., and others.—The dose of salicylic acid recommended for rheumatism is from 5 to 10 grains two or three times a day.

(2) F. H. H. asks: What danger is there in an ordinary coal oil lamp (lighted) when about one third full, or has a large space between the oil and top of lamp? What does the space contain—explosive gas or atmospheric air? A. Unless the best quality of kerosene is used there is great danger of an explosion, as the lower grades of oils give off vapor at ordinary temperatures which, when mixed with a certain proportion of air, form an explosive which requires only fire to develop its power. Many lamp burners are so contrived that it is possible for fire to run down in the wick tube and ignite the explosive below.

(3) C. F. A. asks: Will you be so kind as to inform me, through the columns of the SCIENTIFIC AMERICAN, the relative cost and economy of the rotary engine as compared with other forms of the steam engine? A. While the cost of rotary engines is generally somewhat less than that of the reciprocatory, they have never yet been made to equal the latter in economy. The relative economy depends upon the character and construction of the rotary.

(4) E. H. M. asks: Will shellac varnish form a sufficient insulator for the wire in the helix of a magnet for telegraphic purposes? A. Yes, if carefully applied and wound before it becomes so dry and hard as to crack.

(5) P. S. asks whether it is possible to obtain an electric shock by simply holding the poles of a battery, or must I have a machine? A. You will require an induction coil like that described on p. 203, Vol. 39 (14), SCIENTIFIC AMERICAN.

(6) W. H. writes: I have a job in which there is one radiator that fills with water for about 30 minutes; it cracks and makes a great noise. Please tell me the reason of water and noise, and how to remedy it. I will give you the way the pipes are placed. I start from the boiler with a 2 inch main to the first riser to 1 radiator, then I reduce to 1½ pipe to the next riser to 1 radiator, and then reduce to 1¼ to next riser to 1 radiator, and from this to the fourth and last radiator I reduce to one inch; there is about 30 feet between the two last radiators. It is the last or furthermost from the boiler that is not working right, the second and third risers go to radiators on the third flat; the first and last are on the ground floor or store; the full length of the main from boiler is 65 feet. A. You do not send sufficient data for an intelligent reply, but judging from the action of the water and the noise, your pipes must be too small, or reduce in size too soon. According to the description given, a 1½ inch pipe has to supply steam to every radiator except the first one. When the area of a 2 inch pipe is represented by 4, a 1½ inch pipe is represented by 2¼, which in practice for long lengths should not be valued higher than 2. On page 356, No. 23, Vol. xli., it says: "Mains which have given the best results leave the boiler of sufficient size, and reduce very slowly, if at all, until very near the end."

(7) I. M. asks: 1. What is the horse power of an engine; cylinder diameter, 18 inches; stroke, 20 inches; revolutions per minute, 165; boiler pressure, 80 lb? A. If you call the average pressure on the piston 50 lb. = 212 horse power. 2. Where can I get and what is the best work on mechanical engineering and management and care of steam engines and boilers, and what it will cost? A. "Roper on Land and Marine Engines," "Edwards' Catechism of the Marine Engine," for sale by industrial publishers who advertise in our columns.

(8) J. C. J. asks what books to buy on steam engineering. A. See reply to I. M., above.

(9) C. H. C. writes: I have six cells of a battery, the outer cup or jar is glass, and into this fits a porous cup containing a carbon core and some other ingredients. I also put in the bottom of the cells salammoniac, to produce the electricity. The point I desire to ascertain is, How much salammoniac should I keep in the cells to insure it in a working condition at all times? A. Enough salammoniac should be placed in the cell to form a saturated solution. It will do no harm if some of the crystals are left undissolved in the bottom of the jar.

(10) "Printer" asks: 1. Will a windmill run a cylinder printing press having a reverse motion unlike others? A. We think the speed would be too irregular. 2. Does a windmill always run machinery in the same direction? A. Yes. 3. Can it be regulated as regards speed by anything like a governor? A. Yes; governors are generally used in connection with the best windmills.

(11) H. L. B. asks: 1. Are the wheels of the Hudson River steamers Vibbard and Powell placed precisely amidship? A. They are not precisely in the middle of length, and we do not know their exact position. 2. What are the Powell's dimensions and size of engines and boilers? A. Length 290 feet by 34 feet beam, out to out, by 9 feet 4 inches hold; engine, 72 inches cylinder by 12 feet stroke; 2 boilers, 10 feet diameter of waist, and 25 feet in length.

(12) J. P. M. asks: 1. Is there anything better than a lever to secure a great power in a small space where but little motion is required? A. You might employ the principle of the hydraulic press. 2. If a system of compound levers is used, and not enough motion, can any arrangement be made that will give the increased motion without diminishing the power? A. No.

(13) C. M. writes: I see in No. 2 of SCIENTIFIC AMERICAN of 1880, in query No. 11, of W. S. W., how to find the cubic contents of a cylinder, your answer is to multiply the diameter by the decimal 0·7854. I wish to make a correction. It is to multiply the square of the diameter, that is, the diameter multiplied into itself, by the decimal 0.7854 to get the area, then multiplying by the length you get the cubical contents. [You are correct. By some oversight the diameter was given for the square of the diameter.]

(14) H. S. C. asks: 1. How many bushels of coke will it take to melt 1,000 lb. iron in an ordinary medium sized two tuyere cupola? A. From 240 to 280 lb. to one ton. Much depends upon the form and proportions of cupola. 2. How many pounds of coal will it take to melt same amount under same circumstances, bed in both cases to be counted in; whole heat to melt about 10,000 lb. iron, in four charges? A. With anthracite coal and good furnace, from 10 to 12 lb. iron are melted to the pound of coal consumed. 3. About how many bushels of coke will a ton of bituminous coal make if coked to best advantage? A. From 60 to 75 per cent of weight of coal.

(15) E. S. E. writes: A company of gentlemen have agreed to ask your opinion upon a question which hopelessly divides them. I maintain that the reason a railroad engineer is placed upon the right side of his locomotive (thereby compelling him to use his left hand to control the levers) is because it is natural for him to do so; that is, the instinctively uses his left hand for many delicate operations, and his right where strength is the main requirement. In violin, and occasionally in piano playing, this appears. My opponents say that the mentioned peculiarity of locomotives is accidental. I contend that there is a reason for it, and that it is only a recognition of a fact, which though not explainable, is patent to all. A. There is no special reason for the position of the engineer except habit and custom. Some years since, on several railroads the engines passed on the left side of each other, that the engineer might have a clear view of approaching trains; but we believe that in every case they have now changed to pass on the right, as is now the rule.

(16) F. H. L. writes: 1. Suppose a windmill built with sails in the ordinary manner, but not turning to face the wind, and suppose friction, etc., reduced to a minimum. Would the number of turns per minute vary as the velocity of wind, when the wind was in the direction of the axis? That is, if n = number revolutions per minute, v = velocity in miles, and C some constant, should we have $n = Cv$? A. Yes, the pressure is as the velocity. 2. If the wind made an angle, A, with the axis, should we have $n = Cv \cos A$? A. Whatever angle the course of the wind makes with the axis, the speed will vary as the velocity of the wind so long as the direction is unchanged.

(17) H. M. asks: 1. What are the chemical properties of telegraph wire? Which of its separate properties act as a conductor of electricity? A. All metals, as well as many non-metallic substances, are to a certain extent conductors of electricity. The precise manner in which electricity is transmitted through these is not definitely known. As to the chemical nature of metals, consult some elementary work on chemistry. 2. Is there anything of a transparent nature a conductor of electricity—either a liquid or solid, solid preferred—that will not be affected by the current? A. We know of no such substance. Acidulated water conducts electricity, but slowly suffers decomposition by its action.

(18) Short Hand.—"Student" and others ask: 1. What is the best system of short hand? A. There is no demonstrably "best" system. Any one of numerous systems in use will serve well enough as a basis for the beginner. Ultimately every successful reporter has to develop his own system in accordance with his experience and the requirements of his own hand and mind. The man who has the rare qualifications of quick and tenacious memory, unlimited patience, nice discrimination of form, and capacity for manual skill, requisite for rapid reporting, will succeed with any system. Some of the most successful reporters have based their writing on ordinary script. 2. Can short hand be learned without a teacher? A. Probably nine out of every ten reporters have acquired the art without a teacher. A good teacher, however, will be of great assistance to the learner. 3. How long will it take to learn to report? A. Three months under good instruction, with several hours' daily practice, will suffice for easy work, proper capacity and industry on the part of the learner being assumed. The great majority of those who attempt the art, however, fail to acquire skill enough, after years of practice, to report a fairly rapid speaker. 4. Are there any good books on the subject? A. Any bookseller's list will show numbers of them, each and all guaranteed to be the very best. 5. Is reporting a profitable occupation? A. No, generally speaking. Still there is no occupation which cannot be made to yield a living, often very much more, to any one of proper capacity who will pursue it with prudence, zeal, and energy. Considering, however, the great time and labor required to master the art of short hand reporting, and the low average reward, the occupation is not an inviting one. Nevertheless as an auxiliary to other lines of business short hand is well worth studying by any one who has time for it. The incidental training of hand and eye and memory is valuable.

(19) R. B. N. asks (1) how to cut carbon sticks in the best manner. A. A hardened steel point drawn along a straight edge, and at the same time pressed against the carbon with considerable force, will cut it if the strokes are repeated a sufficient number of times. 2. What mixture with bichromate of potash is used in the battery which consists of a zinc plate suspended between two carbon plates? A. Dissolve 2 parts of bichromate of potash in 20 parts of warm water. When cold add slowly 1 part of sulphuric acid. 3. Is there a cheap device by which I can wind wire on an iron core for an induction coil? A. See directions for making an induction coil, p. 203, Vol 39, SCIENTIFIC AMERICAN, and SUPPLEMENT, No. 160.

(20) W. H. A. writes: There are being constructed in Illinois a line of towers extending longitudinally across the State, made of wood, frame of pyramidal shape, ranging from 125 to 200 feet high, from 1 to 3 miles apart, as we understand. What is their purpose? A. They are used by the engineers in the United States Survey Service in triangulation.

(21) G. S. J. asks (1) if platinum is fusible in the electric arc of the ordinary carbon lamp. A. Yes. 2. Is there any substance that is not fusible in the electric arc, and at the same time a non-conductor of electricity? A. There is no known substance that has these qualities.

(22) L. M. writes: 1. All our machinery is not having been run more than four months. We have a battery of fine boilers, one of which has on the first sheet a flaw in the iron above the fire box about 1-3 of the way up the side of the boiler; it is about 12 inches long and has a ragged appearance. This outside shell is about ½ thick. The boiler is of ⅜ plate. We carry 80 to 95 lb. steam. Do you think it is dangerous to run it in this condition? A. Yes; repair your boiler before using. 2. Our hoisting engines are strongly built, size of cylinder 12x20, the best time we can make is 9 seconds; throttle open wide, 90 lb. steam. The coal is hoisted one hundred feet out of a shaft. How can I make the engines quicker, without increasing the steam pressure? The valves have ⅛ lead, ⅜ lap, steam cut-off at ¾ stroke. A. We think you cannot make them quicker, if you have now proper size of openings. 3. Is there any such an invention as an apparatus for opening the doors of locomotives by means of levers or springs? A. We know of no such thing in practical use.

(23) W. F. asks (1) why an engine in making a curve will travel more on the high than on the low side. How do they do it when the wheels on both sides are making the same number of revolutions? A. The face of the tire is generally "coned," and the outer wheel runs on a larger diameter; also, the inside wheel slips or slides to a certain extent, depending on the radius of the curve. 2. On what principle does an injector work? A. By the velocity and consequent momentum given the water by the effluent steam.

(24) V. V. G. asks: Will a locomotive without train, with a 4½ foot wheel disconnected on one side, be equal to a 9 foot wheel? Will a locomotive run faster with one side disconnected? A. The locomotive will not travel faster than the wheel travels. Disconnecting one side makes no difference so long as the wheels have the same velocity.

(25) R. H. D. asks: What is the best way to irrigate a strawberry field, ½ acre, water to be taken from a lake, highest point 9 feet above low water; greatest distance 200 feet; time water is wanted, during the month of June? I can pump in a tank by hand and spread by gravity, or draw with team and self-filling tank attached under wagon. Is there a better or cheaper plan? A. Put up a windmill to pump into your tank, and spread by gravity.

(26) W. F. H. writes: We had a 40 horse power tubular boiler to test with water pressure; took the water from a pond covered with ice, boiler was out doors; thermometer about 26°, or 6° below freezing, cloudy day; gave it a pressure of 120 lb. in that condition. How much steam pressure would it be equal to? I claim it would be as hard on the boiler as 150 lb. steam or hot pressure. A. It would be harder on the boiler, because the water has no elasticity, while the actual pressure would be the same. The iron would also be more brittle at the low temperature.

(27) A. B. P. writes: I have a large cistern, and the pipe that feeds my boiler is constantly five feet under water. Would it be injurious to the boiler, or in any way objectionable, to let the exhaust from the engine into the cistern at the top of the water, if I use country tallow only in the cylinder? A. No, unless you use the tallow in large quantity.

(28) G. H. C. asks: 1. What was the depth of girders and what was the width from outside to outside of same across the track on the recently destroyed spans of the Tay bridge? A. Depth 27 feet, width between girders about 12 feet. It was a single track bridge. 2. Are hexagonal nuts ever used on bolts in fish plates in this country, or are they all square? A. They are almost invariably square. 3. Is a fish plate bolt screwed up tight as any other bolt in any piece of machinery, or is it left moderately loose to admit of expansion and construction of rails? A. It is screwed up tight, but the fish plate has a little elasticity.

(29) A. O. K. writes: 1. I have charge of a boiler of the locomotive type. I have considerable trouble with leaks at the bottom of the water legs, caused by fractures in the cast iron "ring" surrounding the fire box. Calking does no good; I have also tried a cement of iron turnings, salammoniac, and sulphur, placing it on the cracks, but that also failed to stop the leaks. Bran does better, but does not stop them entirely. How can they be stopped effectually? A. First use coarse Indian meal on the inside, and when it has worked well into the cracks, fill above it with hydraulic cement 1 to 2 inches thick, being careful that the top of the cement is some distance below the top of grate bars. 2. I want to black small casting by dipping. Can you give a recipe for a paint for this purpose that will have a gloss after becoming dry? A. Use asphaltic black varnish.

(30) A. R. B. writes: Riding with a friend recently, he asserted that the wagon brake produced greater effect in retarding the vehicle when barely allowing the wheels to turn, than when it locked them entirely. I said he was mistaken, but could give him no satisfactory reason. Am I right, and if so, please explain why? A. Your friend is correct. It is true also of railroad brakes when the wheels are locked; the same surface is constantly presented for friction and soon becomes glazed; when allowed to turn, new surfaces are presented.

(31) C. E. B. asks: 1. Of what kind of metal is the rings in an engine cylinder composed of? A. Generally cast iron. 2. How can I run Babbitt metal boxes for a saw mandrel or other shafts? A. Fit a mandrel the size of the shaft in the box and cast around it.

(32) J. H. W. asks for a recipe for a toilet lotion that will improve complexion of ladies, which contains nothing injurious. A. We do not recommend such lotions. Temperate living, plenty of out-of-door exercise, and frequent bathing impart a clear vigor to the skin attainable by no artificial means.

(33) J. F. P. writes: I have a well that is 20 feet deep, and I have a pump with 1 inch gas pipe; it is common iron piping. The water tastes a little of the iron. How can I keep it from tasting? A. Use wood tubing instead of the iron pipe.

(34) J. C. S. asks: How can cattle hoofs or horns be melted so as to form a transparent composition? A. Horns are soaked in hot water until the bone is easily separated, when they are softened in hot water, slit up, and spread out between warm plates under pressure. From these plates the articles referred to are cut. Hoofs are usually cold pressed. Neither are melted as suggested.

(35) J. A. W. writes: Can you tell me the usual way of covering lead with powdered chromium for negative plates, and do you consider such plates equal to carbon? Do you know of an imitation or any substitute for hard rubber? A. The metallic chromium, according to Beasley, is pressed into the surface of the lead by passing between steel rolls. It compares favorably with carbon in some electrotypes. Celluloid can be made to closely resemble ebonite or vulcanite.

(36) J. S. writes: I wish to build a small steam launch of the following dimensions: Length over all 25 feet, beam 5 feet, depth 3½ feet. Boiler 24 inches diameter, 36 inches high, 90 or 100 one inch tubes. Engine, cylinder 5 inches by 6 inches stroke, working pressure 150 lb. The exhaust steam to be led through the bottom of the boat and along the keel to and around the stern, then forward and empty into a tank in the boat. The diameter of the exhaust pipe will be 1¼ inches, length about 30 feet under water. Will 30 feet of 1¼ inch pipe have enough surface to condense all the steam; if not, how long ought the pipe be? A. No; do not use less than 2 inch pipe.

(37) R. E. W. asks: By what process is condensed milk made? A. The fresh milk is pumped into large air tight vessels (vacuum pans) placed over a warm water bath and connected with air pumps, by which a partial vacuum is maintained within them. Under these circumstances the milk boils and parts with its water at a very low temperature. Where the milk so condensed is to be preserved for a very long time, it is mixed with a certain per cent of pure white sugar and put up in hermetically sealed cans.

(38) A. B. F. asks (1) for the dimensions of a scow that will carry about 40 tons of freight in addition to her engine, and not draw over 18 inches of water. A. About 75 or 80 feet long and 15 feet beam. 2. What would be the power of an engine to drive it at about 4 miles per hour with a stern wheel? A. Two engines, 6 inches cylinder and 2 feet stroke. A. Which is best for such a boat, an engine with one cylinder or one having two cylinders? A. Two engines.

(39) F. A. S. asks: Is it true that Bessemer steel cannot be used for mould boards for plows, or bottoms of road scrapers. A. Yes. 2. Is it because such steel cannot be properly hardened? A. Yes. 3. If it cannot be made sufficiently hard, why is it? A. It contains too little carbon to be materially affected by the ordinary hardening processes.

(40) J. B. R. writes: I have a private telegraph line, two wires, ⅜ mile long. The line is annealed wire, such as tin men use in putting up stoves. The line has been in use three years. It has been broken several times and spliced. I use three cells Watsons battery to charge the line. It works good for three or four days, then it ceases to work until I cross the wires in the office for a few minutes, then it will work again as stated. Why will it not work all the time? The current is very strong when I cross the wires in the office. A. Without further data we cannot explain the action of your line. It is probable, however, that the resistance of your line is excessive. Use regular telegraph wire. If you require a small wire, use copper.

(41) F. H. L. asks if there is any composition of brass that can be melted in an ordinary coal stove that is of sufficient hardness to cast small models from and its composition. A. Common yellow brass may be readily melted in a coal stove, but it is doubtful if brass can be easily made in an ordinary stove, as the copper, which must be first melted, fuses at a much higher temperature than brass. A very good formula for yellow brass is copper 70 parts, zinc 30 parts.

(42) J. A. C. asks how are the teeth put in the small bracket saws not larger than 1-16 inch wide. A. A number of steel plates having the thickness of the saws are clamped together and placed in a milling machine, which cuts teeth in the edges of the whole series of plates simultaneously. The saws are then sheared from the edges of the plates, and the plates are again melted, and so on.

(43) G. D. R. writes: On page 69, current volume, SCIENTIFIC AMERICAN, I find an article by G. F. Barker, entitled "Crystallization in Canada Balsam." I have frequently observed the figures assumed by balsam or Damar varnish, when boiled between slips of glass; and they are like the cut in the article referred to. If the gum is thick enough and allowed to cool under pressure, the figures are permanent. I am not prepared to dispute or discuss anything; but unless I was sure the glass in question had not been exposed to a "prairie fire" or some other source of heat, I should say heat was the cause of the figures instead of crystallization, as a heat sufficient to boil balsam will not char wood, or if carefully applied, scorch varnish. My proposition can be easily demonstrated by any one with a drop of balsam and two small pieces of window glass.

(44) B. T. F. writes: In SCIENTIFIC AMERICAN, February 7, 1880, page 91, article 4, C. M. K. asks: What will drive away or destroy fleas? I reply; Persian insect powder. I tried it and got rid of the terrible pest.

(45) G. H. writes: Having discovered traces of silver in several places upon large tracks of land we own in this region, we should like to have some simple method of testing or assaying specimens of the rock. From tests made in the East of several different specimens, we are led to believe the stuff will yield from \$35 to \$40 a ton, but wish to try this ourselves. Can you tell us of any simple apparatus? A. Charge into a 6-ounce crucible (a Battersea F answers very well) 1 ounce each of the ore and dry bicarbonate of soda, 2 ounces of litharge (free from silver), ⅛ ounce of argal, and cover with ⅛ inch of dry salt. Heat the crucible until the contents are in a quiet state of fusion, remove from the fire, cool, break, and clean the lead button by pounding on an anvil. If the button weighs more than, say, half an ounce, scorify it down in a scorifying dish in an open muffle. Heat 1¼ inch bone ash cupel in the muffle, drop into it the button, and keep up the temperature of the muffle to a bright red heat until all the lead has been scorified off and absorbed by the cupel, and the small bead of gold or silver (if the ore contains any) becomes well rounded and clear. The ore must be finely powdered, and the whole of it passed through an eighty-mesh sieve.

(46) E. B. L. asks: How to cut up and work into shape retort carbon. It is very hard, and will turn the edge of everything I have tried. A. It is worked in the same manner as glass or stone. To saw it, use a revolving disk of thin sheet iron or copper supplied plentifully with emery and water. To shape it, use an iron lap supplied with sharp sand or emery and water.

(47) G. W. H. asks how can I drill through stone or earthenware vases holes, ¼ in. say, to ⅛ in. diameter? The vases are about ¼ in. thick. A. Use a copper tube for a drill, and supply it with emery and oil.

(48) W. H. P. asks: Who was the first man who had knowledge of the existence of the American continent? A. Seeing that the most ancient vestiges of man thus far discovered have been found on this continent in formations antedating a portion, if not the whole, of the Glacial Period, history may be pardoned for not recording the first comer's name. The first white man certainly known to have visited our continent was Leif Ericsson, in the year 1001. There are traditions of earlier voyages of Europeans to America, but the historical evidence of such visits is insufficient.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

January 20, 1880,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, or any patent issued since 1867, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Air, apparatus for separating the water of condensation from compressed, S. B. Hunt	223,648
Air, pneumatic apparatus for economizing compressed, S. B. Hunt	223,649
Album clasp, S. Posen	223,756
Animal trap, R. Raby, Jr.	223,757
Animal trap, A. G. Rogers	223,760
Balcony, portable, H. H. De Wolf	223,638
Bale tie, cotton, W. D. Field	223,723
Bed canopy frame, W. W. Whitehead	223,687
Bedstead, cabinet, J. W. Stanton	223,770
Blind slat fastening, Robinson & Sunderlin	223,653
Boiler furnace, steam, H. Cowell	223,635
Book binding, J. J. Hanlon	223,672
Boot and shoe edge burnishing machine, H. D. Stone	223,772
Boot and shoe sole, Darozir & Dion	223,712
Boot, rubber, G. Watkinson	223,783
Boot treeing machine, J. E. Crisp (r)	9,055
Bow and arrow rack, E. T. Church	223,667
Bracelet, W. C. Edge	223,669
Boiler furnace, L. B. Parks	223,680
Burial casket, J. Taylor	223,776
Butter worker, J. Sattison	223,654
Camphor, apparatus for refining, W. V. McKenzie	223,747
Cane handle, telescopic, Chandley & Wilson	223,706
Car coupling, E. J. Clark	223,794
Car coupling, H. E. Henwood	223,733
Car coupling, E. Shafer	223,766
Car coupling, C. G. Weldling	223,686
Car door fastening, Buser & Shaw	223,705
Cars, ventilating and refrigerating, J. B. Eliot	223,640
Carbureting apparatus, D. P. Sanders	223,763
Caster, furniture, C. J. Brackebush	223,702
Chain, drive, L. W. Stockwell	223,683
Check rower, E. A. Morphew	223,679
Churn, G. R. Nebinger	223,652
Churn and butter worker, combined, E. Williams	223,786
Churn dasher, J. E. Finley	223,642, 223,643
Churn operating device, J. B. Bolinger	223,700
Cigar light, E. L. Bryant	223,704
Clock movement, A. E. Hotchkiss	223,673
Clothes pounder, H. Howell	223,647
Cornice, adjustable window, W. W. Bolles	223,699
Cotton gin, W. L. Ellis	223,721
Cultivator, J. J. Deal	223,713
Cultivator, comb'd riding and walking, J. Pierpont	223,755
Cultivator teeth, coupling joint for, D. C. Owen	223,752
Currycomb, M. Sweet	223,775
Door plates, making, H. D. Kramer	223,740
Drum, heating, W. C. Doddridge	223,715
Exercising machine, O. Duplessis	223,668
Felt fabrics, manufacture of wool, E. Belknap	223,633
Fence, barb, Walsh & Dutot	223,780
Fence post, H. M. Beecher	223,665
Fifth wheel, J. Wampach	223,782
Filtering apparatus, M. Lansburgh	223,741
Firearm lock, W. W. Wetmore	223,662
Firearm, magazine, W. Trabue	223,660
Firearm, revolving, P. A. Holter	223,645
Fish, preserving, H. Sellman *et al*	223,682
Flame regulating device, F. Koesewitz	223,678
Flour mill dust separator, G. T. Smith	223,655
Fruit gatherer, J. P. Eddleman	223,720
Gelatine for vitrifiable prints, preparation of, E. Salvy	223,762
Glass working, machinery for handling blow pipes in, R. Gray	223,726
Glassware, manufacture of, J. M. A. Deherrypon	223,637
Grain binder, W. M. Piatt	223,754
Grain binder, D. Strunk	223,773
Grain meter, W. H. Allen	223,692
Grate, J. Collins	223,634
Grinding and polishing implement, T. B. Stone	223,771
Harness breeching stay, M. M. Sulgrove	223,774
Horse rake and hay spreader, G. N. Palmer (r)	9,050
Horseshoe, D. Hudson	223,737
Hydraulic motor, Class & Briegleb	223,707
Hydraulic press, J. Watson	223,785
Ice cream freezer, C. W. Packer	223,753
Ice cream freezer, T. Scantlin	223,765
Inhaler, nasal, J. H. Yates	223,792
Iron and steel, manufacture of, J. Reese	223,758
Jeweler's clamp, A. A. Cowing	223,711
Journal box, anti-friction, E. D. Draper	223,639
Knitting machines, needle cylinder or bed of, S. Cornfield	223,710
Lamp, electric, F. Winters, Jr.	223,790
Lamp regulator, electric, Houston & Thomson	223,646
Lathe feed mechanism, J. Houck	223,736
Lens, optical, L. Allen	223,627
Lock, E. Juhl	223,739
Locomotives, tramway and other, J. Matthews	223,746
Loom, J. Lyall (r)	9,049
Magnetic-electric machines, armature and commutator for, Thomson & Houston	223,658
Magneto-electric machines, automatic adjuster for commutator brushes on, Thomson & Houston	223,659
Marine transshipment and overland transportation, A. Toellner	223,685
Measuring machine, cloth, O. W. Dodson	223,716
Milk cooler, D. Van Hovenberg	223,661
Mill for reducing, levigating, etc., L. Smith	223,769
Mower, lawn, J. H. Olcott	223,750
Music sheets, apparatus for cutting pattern plates to be used in making perforated, G. B. Kelly	223,676
Musical instruments, making perforated sheets for mechanical, G. B. Kelly	223,675
Neck band shaper, W. H. H. Tracy	223,778
Packages, apparatus for expelling substances from, W. H. Macy, Jr.	223,743
Pantaloons holder, J. F. & T. Reinhardt	223,681
Paper cutting machine, Leviness & Vanhorn (r)	9,054
Paper cutting machine, A. Malm	223,744
Paper feeding machine, F. H. Lauten	223,742
Paper, making paneled, Sipe & Rogers	223,768
Paper pulp from wood, etc., making, W. E. Farrell	223,670
Partition, wooden, F. G. Himpler	223,734
Pen, movable cattle, D. Harrington	223,729
Pen, stylographic fountain, Hawkes & Madeheim	223,644
Pens, fountain attachment for writing, T. Willans	223,788
Plastered wall, A. H. Becker	223,696
Plow, A. G. Christman	223,666
Plow, J. H. Close	223,708
Plow point, J. Oliver	223,751
Portable and road engine, B. Yoch (r)	9,052
Porte monnaie, G. C. G. Williamson	223,789
Preserving grapes, etc., apparatus for, C. J. Renz	223,759
Pulley block sheave, C. H. Hadley	223,795
Pump, H. R. Baker	223,631
Pump, rotary, J. M. Taylor	223,684
Pumping engine, N. W. Wheeler	223,663
Punching machine, gunpowder, T. Shaw	223,767
Quartz, etc., method of and apparatus for pulverizing and separating metalliferous, S. F. Hodge (r)	9,053
Quartz mill feeder, T. A. Cochrane (r)	9,048
Railway head, C. W. Anderson	223,629
Refrigerator, D. C. Sanford	223,764
Roof, composition, T. Fugate	223,671
Rotary engine, J. A. Adams	223,688
Saddle box loop, harness, O. Rosencrans	223,761
Sausage stuffer, A. Diffenderfer	223,714
Scale beam, H. Willard	223,787
Screws or bolts, machine for rolling threads of, H. A. Harvey	223,730
Sewing machine and trimming device therefor, J. E. Wiggins (r)	9,056
Sewing machine button hole attachment, C. M. Banks	223,694
Sewing machines, clutching and breaking device for power driven, L. Sternberger	223,656
Shearing horses, device for, F. Y. Wolseley	223,664
Sidewalk, D. Watson	223,784
Sign, H. J. Blowney	223,698
Slate frame, noiseless, W. S. Davis	223,636
Spinning machine, T. Mitchell	223,748
Spinning machine, ring, Howland & Lawton	223,674
Spinning spindle bolster, R. Gillman	223,724
Square, framing, M. B. Cornell	223,709
Square, protractor, etc., combined, S. D. Halley	223,727
Steam and hot air pipes covering, A. B. Battelle	223,695
Steam engine reversing gear, W. Baxter	223,632
Steel, tempering, J. C. Jenkins	223,738
Stirrup, H. D. Adel	223,690
Stone crusher, T. A. Blake	223,697
Stone or marble, making artificial, W. H. Hoopes	223,735
Straw cutter, D. A. Walker	223,781
Suspenders, M. Altmann	223,628
Switch and signal connections, foundation for, C. H. Jackson	223,650
Telephone, voltaic transmitting, A. K. Eaton	224,718
Thill coupling, C. Worthen	223,792
Thill couplings, anti-rattler for, J. S. Healey	223,731
Tin and other metal ware, bottom for, J. E. Finley	223,641
Tobacco pipe, S. T. Bacon	223,630
Tongue support, vehicle, O. Hebert	223,732
Toy, G. W. Ebright	223,719
Trace fastener, M. M. Bowlus	223,701
Trimming, W. Walker	223,779
Triturating mill, J. H. Mitchell	223,651
Valve, globe or check, J. S. Munger	223,749
Valve, steam engine slide, G. W. Anderson	223,693
Vegetable crusher, H. Adams	223,689
Velocipede, A. M. Allen	223,691
Ventilating and cooling dairies, J. Wilkinson (r)	9,051
Ventilating apparatus, W. F. Thiers	223,777
Wagon brake, automatic, W. P. Wood	223,791
Washboard, E. A. Kitzmiller	223,677
Washing machine, G. W. Dorris	223,717
Washing machine, F. Hamblin	223,728
Whiffletree guard, W. I. Marsh	223,745
Whisk, H. Bradt	223,703
Windmill, S. B. Goff	223,725
Wire, etc., machine for polishing, S. P. M. Tasker	223,657
Wooden rods, polishing round, C. Erk	223,722

DESIGNS.

Carpet, A. Heald	11,608 to 11,610
Carpet, D. McNair	11,611
Carpet, T. J. Stearns	11,612
Carpet, P. Tetrel	11,613
Key bow, F. W. Mix	11,615
Spoon or fork handles, A. Hart	11,614

TRADE MARKS.

Cotton fabrics, unbleached, bleached, and colored, woven, Hill Manufacturing Company	7,796, 7,797
Flour, wheat, Empire Mill Company	7,795
Throat and lung diseases, remedy for, Lawrence & Martin	7,799
Woolen goods, such as cassimeres, suitings, etc., E. Oelbermann	7,798

English Patents Issued to Americans.

From January 16 to January 20, inclusive.

Car starters, J. Hill, Williamsport, Pa.
Elevator, hydraulic, C. W. Baldwin, Brooklyn, N. Y.
Gas regulator, M. G. Wilder, Brooklyn, N. Y.
Paper, compound for, R. A. Fisher, Philadelphia, Pa.
Paper, manufacture of, R. A. Fisher, Philadelphia, Pa.
Paraffin, refining, W. Bell, New York city.
Photo relief engraving, G. C. Bell, Brooklyn, N. Y.
Puddling furnace, W. Stubblebine, Bethlehem, Pa.
Railroad rails, manuf. of, G. Webb, Johnstown, Pa.
Steam boiler, heating apps., J. Evans, Philadelphia, Pa.
Steel, treatment of, G. Webb, Johnstown, Pa.

Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.
(About eight words to a line.)

Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

WOOD SOLE SHOES. The cheapest, most durable, warm, good looking, and thoroughly waterproof shoe. Particularly adapted to Brewers, Miners, and all classes of laborers. Send for circular to CHAS. W. COPELAND, 122 Summer St., Boston, Mass.

RARE CHANCE TO INVEST.—WANTED, PARTNER with $3,000 or $4,000 in established business. Address J. R. McCORMICK, Georgetown, Texas

WALLA WALLA UNION,

A newspaper containing general information about Washington Territory, the Walla Walla and Palouse countries. Subscription, $4. Address THE UNION, Walla Walla, W. T.

$2 WATCHES. Cheapest in the known world. Agents wanted. Address COULTER & CO., Chicago.

COLUMBIA BICYCLE. A practical road machine. Indorsed by the medical profession as the most healthful of outdoor sports. It augments three-fold the locomotive power of any ordinary man. Send 3c. stamp for 24 page catalogue, with price list and full information. THE POPE M'F'G CO., 89 Summer Street, Boston, Mass.

Mill Stones and Corn Mills.

We make Burr Millstones, Portable Mills, Smut Machines, Packers, Mill Picks, Water Wheels, Pulleys, and Gearing specially adapted to Flour Mills. Send for catalogue. J. T. NOYE & SON, Buffalo, N. Y.

H. W. JOHNS' ASBESTOS STEAM PACKING,

In all sizes of rope.

ASBESTOS FLAT PACKING, in sheets and gaskets, all sizes.

ASBESTOS WICK PACKING, For small valve stems, etc.

Are ten times as durable as any others, and are indestructible by fire or acids.

ASBESTOS CEMENT FELTING and AIR CHAMBER COVERINGS, for steam pipes, boilers, etc., are the most effective, durable, and economical non-conductors in the world. They can be readily applied by any one. Send for descriptive price lists.

H. W. JOHNS M'F'G CO., Sole Manufacturers of Genuine Asbestos Materials, 87 MAIDEN LANE, NEW YORK.

WIRE ROPE

Address JOHN A. ROEBLING'S SONS, Manufacturers, Trenton, N. J., or 117 Liberty Street, New York. Wheels and Rope for conveying power long distances. Send for circular.

TRY **THE LEHIGH EMERY WHEEL.**

For catalogue and prices, address LEHIGH VALLEY EMERY WHEEL Co., WEISPORT, PENNA.

SHEPARD'S CELEBRATED $50 Screw Cutting Foot Lathe.

Foot and Power Lathes, Drill Presses, Scrolls, Circular and Band Saws, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc. Send for catalogue of outfits for amateurs or artisans. H. L. SHEPARD & CO., 331, 333, 335, & 337 West Front Street, Cincinnati, Ohio.

FRIEDMANN'S PATENT **EJECTORS**

Are the cheapest and most effective machines in the market for

Elevating Water and Conveying Liquids

from Mines, Quarries, Ponds, Rivers, Wells, Wheel Pits; for use in R. R. Water Stations, Factories, etc. They are splendidly adapted for conveying liquids in Breweries, Distilleries, Sugar Refineries, Paper Mills, Tanneries, Chemical Works, etc. Send for illus. catalogue to NATHAN & DREYFUS, Sole Manufacturers, NEW YORK.

CARNEGIE BROS & CO UNION IRON MILLS PITTSBURGH PA. WROUGHT IRON BEAMS CHANNELS TEES & ANGLES

The attention of Architects, Engineers, and Builders is called to the great decline in prices of wrought STRUCTURAL IRON. It is believed that, were owners fully aware of the small difference in cost which now exists between iron and wood, the former, in many cases, would be adopted, thereby saving *insurance* and avoiding all risk of *interruption to business* in consequence of fire. Book of detailed information furnished on application.

BOILER COVERINGS.

WITH THE "AIR SPACE" IMPROVEMENTS.

THE CHALMERS-SPENCE CO., Foot E. 9th St., New York. Sole owners of the Air Space Patents.

RUE MANUFACTURING COMPANY. TRY IT. RUE'S LITTLE GIANT INJECTOR. IMPROVED. IT IS RELIABLE. THE GREAT BOILER FEEDER. LOCOMOTIVES. STATIONARY BOILERS. 523 CHERRY ST. PHILADELPHIA, PA. SEND FOR CIRCULAR.

Gear Molding without Patterns

Scott's Gear Moulding Machines,

AIR COMPRESSORS & ROCK DRILLS.

DELAMATER IRON WORKS, Boiler Makers, Engine Builders, and Founders, FOOT OF W. 13th ST., North River, NEW YORK. ESTABLISHED 1841.

SCREW PRESSES, STILES & PARKER PRESS CO., Middletown, Ct.

TIGHT & SLACK BARREL MACHINERY A SPECIALTY JOHN GREENWOOD & CO. ROCHESTER N.Y.

THE DRIVEN WELL.

Town and County privileges for making Driven Wells and selling Licenses under the established American Driven Well Patent, leased by the year to responsible parties, by WM. D. ANDREWS & BRO., 235 BROADWAY, NEW YORK.

60 New Styles Chromo and Floral Cards, in case, 10c. 80 agts.' samples, 10c. Stevens Bros., Northford, Ct.

The George Place Machinery Agency

Machinery of Every Description. 121 Chambers and 103 Reade Streets, New York.

DYKES' BEARD ELIXIR A Wonderful Discovery. Forces heavy Moustache or Beard even on smooth faces in from 20 to 30 days. These cuts are from the original, and show a positive result from its use. It works like magic and never fails. No possible injury to the skin, easily applied and certain in effect. Pkg. post-paid 25cts. 3 for 50cts. L. L. SMITH & CO. Sole Ag'ts, Palatine, Ill. All others counterfeit.

BOYLE ICE MACHINE CO., 10 N. Jefferson St., Chicago, Ill. The best Ice and Refrigerating Machines of all sizes and for all purposes guaranteed. Send for circular.

MACHINISTS' TOOLS. NEW AND IMPROVED PATTERNS. Send for new illustrated catalogue. Lathes, Planers, Drills, &c. NEW HAVEN MANUFACTURING CO., New Haven, Conn.

Furnace Hoist.

ELEVATORS. All kinds of Hoisting Machinery a specialty. Steam, Hydraulic, and Belt Power for Passengers and Freight. Iron Furnace Lifts, Portable Hoists. STOKES & PARRISH, 30th and Chestnut St., Phila., Pa.

A New Spinning Band.

ROWBOTTOM'S PATENT DOUBLE LOOPED SPINNING BAND. Suitable for all kinds of Spinning and Doubling Frames for Woolen, Worsted, Cotton, Flax, or other fibrous substances. IS FREE FROM KNOTS, neat, speedily adjusted, runs steadily, and avoids the annoyance of Lint. Price, fifty cents per pound, delivered at the mill. Sample orders solicited. State kind of machinery, diameter of Driving Cylinder, and actual length required when in operation. STODDARD, LOVERING & CO., Sole Agents, No. 10 Milk Street, Boston, Mass.

YOUR NAME and ADDRESS on 50 Gilt, Duplex, etc., Cards, in case, 15c. DAVID BROS., Northford, Ct.

THE SKINNER PORTABLE & STATIONARY ENGINES BOILERS & GOVERNORS FIRST CLASS & ECONOMICAL SKINNER & WOOD ERIE PA SEE ILLUSTRATED ADVERTISEMENT

Lathes, Planers, Shapers

Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. GOULD & EBERHARDT, Newark, N. J.

Working Models

And Experimental Machinery, Metal or Wood, made to order by J. F. WERNER, 62 Centre St., N. Y.

NEW AND 2D-HAND ENGINES AND BOILERS CHEAP for cash. O. B. GOODWIN, Oil City, Pa.

SALESMEN WANTED $125 A Month and Expenses selling to DEALERS. SAMPLES FREE. Send 3c. STAMP to insure answer. **CIGARS** S. FOSTER & CO., Cincinnati, O.

Roots' Improved Portable Forge

P. H. & F. M. ROOTS, M'f'rs, Connersville, Ind.

S. S. TOWNSEND, Gen. Agt., } 6 Cortlandt St.,
WM. COOKE, Selling Agent, } NEW YORK.

☞ SEND FOR PRICED CATALOGUE.

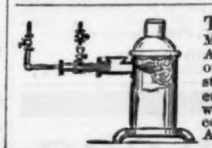
PERFECT **NEWSPAPER FILE**

The Koch Patent File, for preserving newspapers, magazines, and pamphlets, has been recently improved and price reduced. Subscribers to the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT can be supplied for the low price of $1.50 by mail, or $1.25 at the office of this paper. Heavy board sides; inscription "SCIENTIFIC AMERICAN," in gilt. Necessary for every one who wishes to preserve the paper. Address MUNN & CO., Publishers SCIENTIFIC AMERICAN.

HARTFORD STEAM BOILER Inspection & Insurance COMPANY.

W. B. FRANKLIN, V. Pres't. J. M. ALLEN, Pres't.
J. B. PIERCE, Sec'y.

80 Samples Photo, Duplex, etc. Cards, 10c. Autograph Album, 13c. CONN. CARD Co., Northford, Ct.

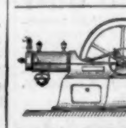


THE FORSTER-FIRMIN GOLD AND SILVER AMALGAMATING COMP'Y of Norristown, Pa., will grant state rights or licenses on easy terms. This system works up to assay, and recovers the mercury rapidly. Apply as above.

ORGAN BEATTY PIANO NEW ORGANS 13 Stops, 3 set Golden Tongue Reeds, 5 Oct's, 2 Knee Swells, Walnut Case, warnt'd 6 years, Stool & Book $98. New Pianos, $143 to $255. ☞ Newspaper sent Free. Address Daniel F. Beatty, Washington, New Jersey.

Pyrometers. For showing heat of Ovens, Hot Blast Pipes, Boiler Flues, Superheated Steam, Oil Stills, etc. HENRY W. BULKLEY, Sole Manufacturer, 149 Broadway, N. Y.

THE PICTET ARTIFICIAL ICE COMPANY, Limited, Ice Machines to make from 20 pounds per hour to 50 tons per day, at 36 Cortlandt St., New York. P. O. Box 3083.



An engine that works without Boiler. Always ready to be started and to give at once full power. SAFETY. ECONOMY. CONVENIENCE. Burns common Gas and Air. No steam, no coal, no ashes, no fires, no danger, no extra insurance. Almost no attendance.

THE NEW OTTO SILENT GAS ENGINE. Useful for all work of small stationary steam engine. Built in sizes of 2, 4, and 7 H. P. by SCHLEICHER, SCHUMM & CO., 3045 Chestnut Street, Phila., Pa. H. S. Manning & Co., 111 Liberty St., N. Y., Agents.

FOR SALE.

One of the best plantations in the valley of the Savannah, twelve miles below AUGUSTA, GA.

The railroad to Savannah divides the land.

Hollywood, with depot, is on the place.

It consists of two thousand acres—one thousand cleared, balance in forest.

Good residence, with barn, stables, gin house, etc., in good repair.

Sixteen first-class mules; fifty head of good cattle; sixty hogs, with 2,000 bushels of corn; abundance of forage and necessary farming implements.

We pledge our word that this is one of the best plantations and stock farms in this State, and very cheap, with liberal terms. Titles perfect.

A. H. McLAWS, GEORGIA LAND AND MINING AGENCY, 206 Seventh Street, Augusta, Ga.

United States Patent for sale cheap. Well vested. Address C. H. Warrington, Box 486, West Chester, Pa.

FINE GRAY IRON CASTINGS MADE TO ORDER. E. Q. DUTTON, Cato, Cayuga Co., N. Y.

No Sawdust! No Planing!

Thin lumber, 1-16 to ½ inch thick, cut and seasoned by our recently patented machines, equal if not superior to the sawed and planed wood, being smooth, flat, and in all cases perfectly seasoned. Used by the largest manufacturers in the country, and giving entire satisfaction. In addition to our specialty, our usual complete stock of sawed Hardwood, Lumber, and Veneers, figured and plain, Burls, etc.

GEO. W. READ & CO., 186 to 200 Lewis Street, New York.

WATCHES From $2 up; other goods in proportion. Mammoth Illustrated Catalogue **FREE** E. NASON & CO., 111 Nassau Street, New York.

AIR COMPRESSORS. THE NORWALK IRON WORKS CO., SOUTH NORWALK, CONN.

$777 A YEAR and expenses to agents. Outfit Free. Address P. O. VICKERY, Augusta, Maine.

SCIENTIFIC AMERICAN SUPPLEMENT. Any desired back number of the SCIENTIFIC AMERICAN SUPPLEMENT can be had at this office for 10 cents. May also be had or ordered through booksellers and newsdealers everywhere. MUNN & CO., Publishers, 37 Park Row, New York.

WATSONS NON CHANGEABLE GAP LATHE HAS GREAT FACILITIES FOR LARGE OR MEDIUM SIZE WORK JAMES WATSON MANR 1603 S FRONT ST PHILA PA.

ROOFING.

For steep or flat roofs. Applied by ordinary workmen at one-third the cost of tin. Circulars and samples free. T. NEW, 32 John Street, New York.

THE TANITE CO., STROUDSBURG, PA. EMERY WHEELS AND GRINDERS. LONDON—9 St. Andrews St., Holborn Viaduct, E. C. LIVERPOOL—42 The Temple, Dale St.

ROCK DRILLING MACHINES AND AIR COMPRESSORS, MANUFACTURED BY BURLEIGH ROCK DRILL Co. SEND FOR PAMPHLET. FITCHBURG MASS.

CLASSIFICATION OF THE VARIOUS FORMS OF ENERGY. By Dr. O. J. Lodge. A paper of importance to those interested in the science of Physics. Ably treated under the following headings: 1. Newton's Third Law. 2. Definition of Work, + and −. 3. Denial of "Action at a Distance." 4. Definition of Energy. 5. Definition of Working Power. 6. Conservation of Energy, and First Law of Thermo-dynamics. 7. Possibility of Various Forms of Energy. 8. Classification of the Forms of Energy. 9. The Fundamental Forms of Energy. 10. Kinetic and Potential Energy related to the two Factors in the Product Work. 11. Transformation from one form to another. 12. Further Subdivision of the Forms of Energy. 13. Classification Table. 14. Distinction between Energy and Entropy. 15. Distinction between Available and Unavailable Energy and Useful and Useless Work. 16. Reason why the Energy of Ordinary Masses is Available, and 17. Why Planetary Energy is Unavailable. 18. Reasons why Molecular Energy is much of it Unavailable. 19. Extent of Availability of Chemical and Electrical Energy. 20. Dissipation of Energy. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 208. Price 10 cents. To be had at this office and from all newsdealers.

SAWS 40,000 SAWS EMERSON'S ILLUSTRATED SAWYERS HAND BOOKS (FREE) TO ANY PART OF THE WORLD. ADDRESS EMERSON, SMITH & CO. BEAVER FALLS, PA. 3 CENTS EACH

62 Gold, Crystal, Lace, Perfumed, and Chromo Cards, name in Gold & Jet 10c. Clinton Bros. Clintonville, Ct.

WM. A. HARRIS, PROVIDENCE, R. I. (PARK STREET), Six minutes walk West from station. Original and Only builder of the **HARRIS-CORLISS ENGINE** With Harris' Patented Improvements, from 10 to 1,000 H. P.

BROWN'S PAT. SPLIT Shafts, Hangers, PULLEYS At low prices. Largest assortment. A. & F. BROWN, 57, 59, & 61 Lewis St., New York.

1880. 1880. 1880.

The Scientific American FOR 1880.

THIRTY-FIFTH YEAR.

VOLUME XLII. NEW SERIES.

The publishers of the SCIENTIFIC AMERICAN beg to announce that on the Third day of January, 1880, a new volume was commenced. It will continue to be the aim of the publishers to render the contents of the new volume as attractive and useful as any of its predecessors.

Only $3.20 a Year, including postage. Weekly. 52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information, and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc.

All Classes of Readers find in THE SCIENTIFIC AMERICAN a popular *resume* of the best scientific information of the day; and it is the aim of the publishers to present it in an attractive form, avoiding as much as possible abstruse terms. To every intelligent mind, this journal affords a constant supply of instructive reading. It is promotive of knowledge and progress in every community where it circulates.

Terms of Subscription.—One copy of THE SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of **three dollars and twenty cents** by the publishers; six months, $1.60; three months, $1.00.

Clubs.—**One extra copy** of THE SCIENTIFIC AMERICAN will be supplied gratis *for every club of five subscribers* at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

One copy of THE SCIENTIFIC AMERICAN and one copy of THE SCIENTIFIC AMERICAN SUPPLEMENT will be sent for one year, postage prepaid, to any subscriber in the United States or Canada, on receipt of *seven dollars* by the publishers.

The safest way to remit is by Postal Order, Draft, or Express. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to

MUNN & CO., 37 Park Row, New York.

To Foreign Subscribers.—Under the facilities of the Postal Union, the SCIENTIFIC AMERICAN is now sent by post direct from New York, with regularity, to subscribers in Great Britain, India, Australia, and all other British colonies; to France, Austria, Belgium, Germany, Russia, and all other European States; Japan, Brazil, Mexico, and all States of Central and South America. Terms, when sent to foreign countries, Canada excepted, $4, gold, for SCIENTIFIC AMERICAN, 1 year; $9, gold, for both SCIENTIFIC AMERICAN and SUPPLEMENT for 1 year. This includes postage, which we pay. Remit by postal order or draft to order of Munn & Co., 37 Park Row, New York.

THE "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Philadelphia, and 50 Gold St., New York.